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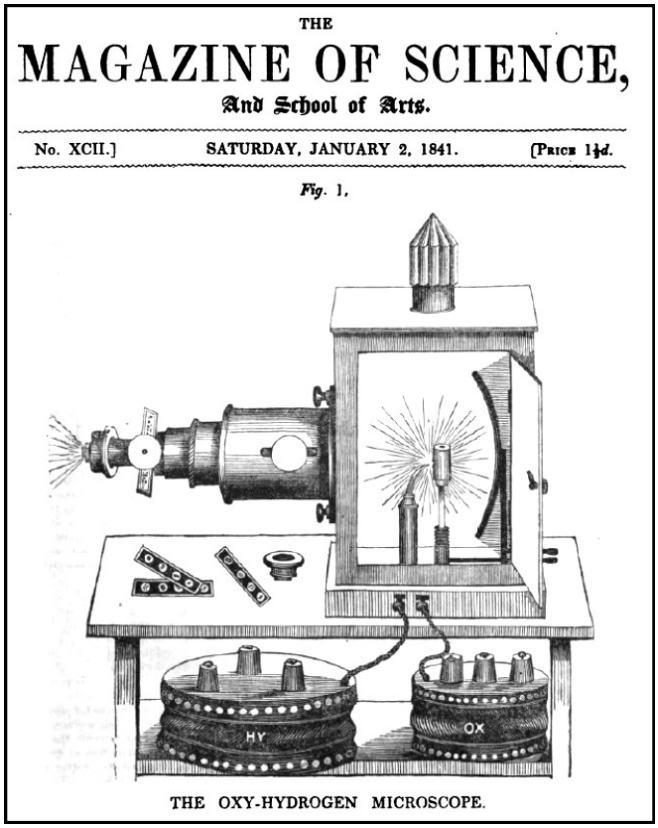
This double issue of the *Gazette* has two articles on magic lantern related topics. The first is my own article on the oxyhydrogen microscope, a sister to the magic lantern. I trace the origins of this instrument back to the marriage of the solar microscope, an 18th century instrument, and the oxy-hydrogen blowpipe, originally used for chemical analysis and secondarily for illumination. The oxyhydrogen microscope (variously spelled with or without a hyphen, or as the hydro-oxygen or gas microscope) was never really an instrument used for scientific research, but rather an attraction for public amusement. Parts of this story have been told by other scholars, but never in a comprehensive way, and the material on exhibitions of the oxyhydrogen microscope in the United States is entirely new. Particularly before the Civil War, audiences wondered at the appearance of fleas the size of elephants, fly eyes, and insect wings, or the feeding of live Water Tigers, the larvae of a type of aquatic beetle.

In the second article, Suzanne Wray describes the "Chemical Dioramas" presented by an obscure lecturer named Jonathan Bohuop in a showboat theater called the Floating Hindoo Pagoda. In the 1850s, Bohuop took his show to small towns and cities along the Ohio and Mississippi Rivers, where it often was hailed as the greatest thing those communities had ever seen. These articles add to our understanding of the variety of itinerant showman who traveled the roads, rails, and waterways in pre-Civil War America.

These two articles also illustrate how this type of scholarship has changed in recent decades. Suzanne and I use similar research methods, mining digital databases of old newspapers and other 19th century sources for advertisements and articles about obscure showmen. So much material has now been digitized that it literally was possible for me to research and write my entire article while sitting at my laptop computer in my house while waiting for and recovering from hip-replacement surgery. Vast archives of old newspapers, although far from complete, provide access to information from major cities and small frontier towns. Resources such as Google Books also make it possible to find references to events or individuals in books currently in print that might otherwise be overlooked. Many times I found that books sitting on my own shelves contained references to the oxyhydrogen microscope that otherwise might have been overlooked. Finally, I was able to read nearly every original scientific paper and book cited in my article without setting foot in a library, allowing me to trace the evolution of the oxyhydrogen microscope in the words of the original inventors.

As always, I am looking for more contributions to the *Gazette* from researchers in North America and anywhere else in the world. Last year we had a series of contributions from young European scholars, but that pipeline has temporarily dried up, and recent submissions have been scarce. Please consider submitting some of your research to the *Gazette*.

Kentwood D. Wells, Editor
451 Middle Turnpike
Storrs, CT 06268
kentwood.wells@uconn.edu
860-429-7458


THE
MAGAZINE OF SCIENCE,
And School of Arts.
No. XCII.] SATURDAY, JANUARY 2, 1841. [Price 1½d.
Fig. 1.
HY
OX
THE OXY-HYDROGEN MICROSCOPE.

Fleas the Size of Elephants: the Wonders of the Oxyhydrogen Microscope

Kentwood D. Wells
451 Middle Turnpike
Storrs CT 06268
kentwood.wells@uconn.edu

The oxyhydrogen microscope, sister to the magic lantern, was a popular feature of public lectures on science in the first half of the 19th century, both in Britain and the United States. Audiences marvelled at images of fleas the size of elephants, fly eyes magnified on a screen to a diameter of 20 feet, or tiny swimming organisms found in a drop of river water. Although commercially produced oxyhydrogen microscopes (also known as oxy-hydrogen, hydro-oxygen, or gas microscopes) resembled limelight magic lanterns with special lens attachments to project microscope slides (Fig. 1), the origins of this instrument trace back to a marriage of two pre-existing instruments, the **solar microscope** and the **oxy-hydrogen blowpipe**.

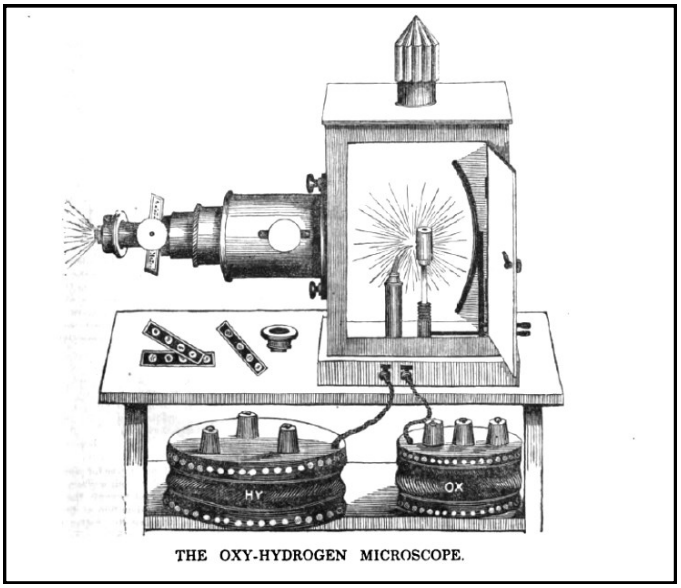


Fig. 1. The oxyhydrogen microscope from 1841. *The Magazine of Science, and School of Arts*, January 2, 1841.

The Solar Microscope

The solar microscope had been used in public lectures and demonstrations in Europe since the 1730s (Fig. 2). It consisted of a set of lenses designed to project microscope slides onto screen using the brilliant light of the sun. The device was equipped with a mirror that could

Fig. 2. Solar microscope made in about 1760 by London instrument maker Benjamin Martin.

http://golubcollection.berkeley.edu/18th/275.html

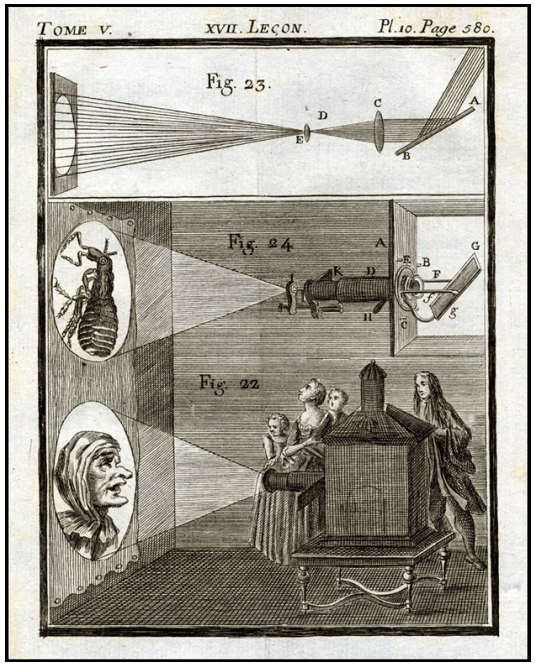


Fig. 3. Solar microscope (top) and magic lantern (bottom). Jean Antoine Nollet, *Leçons de Physique expérimentale*, 1764, vol. 5.

be rotated to follow the movements of the sun. Nevertheless, the main disadvantage of the solar microscope is that it could not be used at night, and on cloudy days, projected images were less than satisfactory.[1]

One of the most spectacular 19th century displays of the solar microscope was the Microcosm, an installation of a dozen or more solar microscopes with ever-changing views, set up in 1827 in the optical shop of Philip Carpenter on Regent Street in London. During the day, the microscopes relied on sunlight, but to extend the exhibition into the evening hours, Carpenter first used much less intense gas lighting, and by the 1830s, he was using "hydro-oxygen gas" illumination (limelight).[2] Alhough solar microscopes continued to be manufactured well into the 19th century, most exhibitors and lecturers preferred to use the more versatile oxyhydrogen microscope.[3]

Robert Hare and the Oxy-hydrogen Blowpipe

Various kinds of blowpipes had long been essential tools for chemists and mineralogists. Their purpose was to introduce a stream of air onto a flame to increase the amount of heat produced when the flame was applied to a chemical, allowing for fusion or melting of the chemical to study its properties. Early blowpipes were tubes with air blown by mouth, but various devices were used to produce a stronger air current. Following the discovery of oxygen by Antoine Lavoisier and Joseph Priestley in the late 18th century, various scientists experimented with the use of pure oxygen in blowpipes to further increase the amount of heat produced, but none actually produced a workable model.

In 1801, a young American chemist, Robert Hare (1781-1858) (Fig. 4), produced a prototype of a device he called a hydrostatic blowpipe, and he published a description of the blowpipe in 1802 in American, British, and French scientific journals. In addition to being a chemistry lecturer at the University of Pennsylvania, Hare was involved in his family's brewery business, and his first model of the hydrostatic blowpipe used a beer barrel as the basis for a pump that used the incompressibility of water to force oxygen and hydrogen out of separate reservoirs through a narrow tube to the mouth of the blowpipe (Fig. 5).

Later versions of the instrument had a somewhat more simplified design (Fig. 6). When the combination of gases was ignited and applied to a chemical, it produced a more intense heat that any previous type of blowpipe. Other American scientists praised Hare's invention as one of the great discoveries in chemistry, and he was the first recipient of the Rumford Prize, given by the American Academy of Arts and Sciences, in 1839, 18 years after his invention. Several other scientists, including

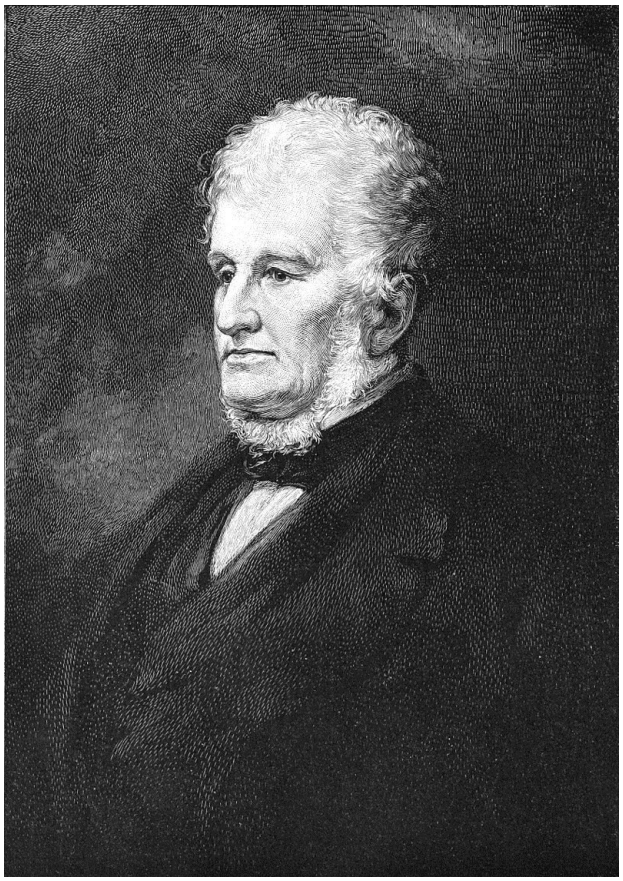


Fig. 4. Robert Hare, American inventor of the oxy-hydrogen blowpipe.

Popular Science Monthly, Volume 42 (1893)

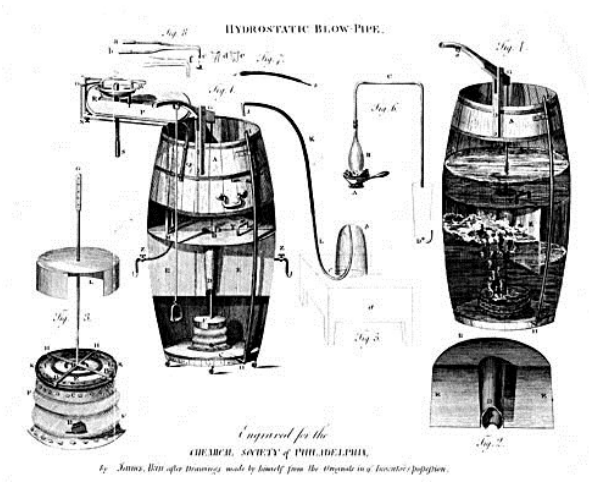


Fig. 5. Robert Hare's original hydrostatic oxy-hydrogen blowpipe (1802).

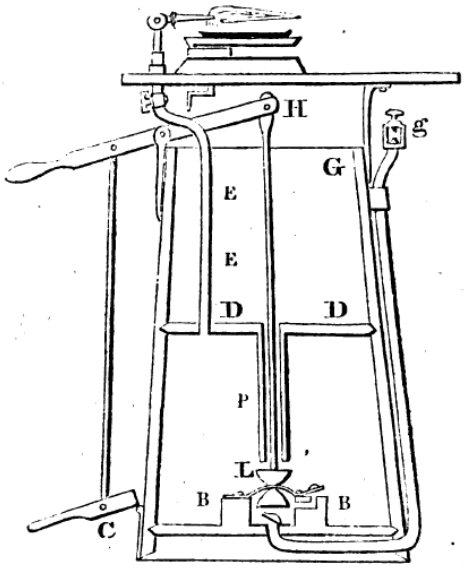


Fig. 6. Refined model of Hare's hydrostatic oxy-hydrogen blowpipe, which he used for many years for chemical experiments. Robert Hare, M.D. 1828. *Compendium of the Course of Chemical Instruction in the Medical Department of the University of Pennsylvania*, p. 74.

Yale's Benjamin Silliman (1799-1864) (Fig. 7) and transplanted Englishman Joseph Priestley, witnessed his demonstration. Silliman conducted extensive experiments with Hare's instrument and published numerous papers on the subject.[4]

Throughout his career, Hare complained that he had not received sufficient credit for inventing the oxy-hydrogen blowpipe, especially from British scientists. He particularly objected to his treatment by Edward D. Clarke (1769-1822), Professor of Mineralogy at Cambridge University (Fig. 8). Clarke described a hydrostatic oxy-hydrogen blowpipe in 1819, which Hare considered to be very similar in design to his own blowpipe. Clarke largely ignored Hare's work. When John Griffin published *A Practical Treatise on the Use of the Blowpipe* in 1827, he barely mentioned Hare's 1802 description of his hydrostatic blowpipe, but did give a detailed comparison of the results of chemical experiments conducted by Hare and Clarke.[5]

Hare complained about the perceived neglect of his invention in numerous publications. In a chemistry textbook published in 1828 for the use of his medical students at the University of Pennsylvania, he included a detailed and rather harsh assessment of Clarke's work in an appendix, "Strictures on a publication entitled Clarke's gas blowpipe." In one passage, he stated "Dr. Clark [Clarke] pretends that the process he has employed is the best. Admitting this, would it afford him any excuse for taking so little notice of mine, or

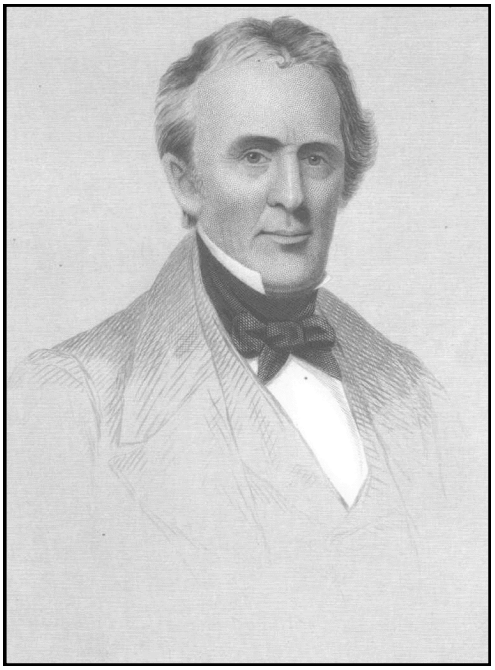


Fig. 7. Yale scientist Benjamin Silliman, who conducted experiments with Hare's oxy-hydrogen blowpipe and defended Hare's priority as the inventor of the device.

attributing the discovery of it to others, especially while professing to give a *fair history* of this invention?" He went on to say "The author of this *professedly candid* publication would wish to convey the idea of my apparatus being so inferior in power to that adopted by him, as to render it unnecessary, in a history of the invention, to quote my experiments."[6] Benjamin Silliman, who became a champion for Hare's priority, also used every opportunity to praise Hare's work, and by extension, his own experiments with Hare's instrument, which had been equally ignored by both Clarke and Griffin. Hare and his American champions continued for more than half a century to criticize British scientists and instrument makers who claimed to have invented or improved the oxy-hydrogen blowpipe.[7]

A major problem with many of the early oxy-hydrogen blowpipes, including Clarke's, was the danger of explosion through backfire if burning oxygen and hydrogen were draw back into the blowpipe, causing the reservoirs to ignite. Indeed, Clarke found his own oxy-hydrogen blowpipe so dangerous that he "resorted to the expedient of building up a brick wall between himself and his instrument," which no doubt limited the practical use of the apparatus. One solution to this problem was to narrow the tip of the blowpipe to reduce backflow of gas. Another was to

Fig. 8. Edward D. Clarke, accused by Robert Hare of ignoring Hare's work on the oxy-hydrogen blowpipe.

keep constant pressure on the reservoir of gas to ensure a steady one-way flow through the pipe to the flame. A major contribution to safety and convenience was an oxy-hydrogen blowpipe designed in 1823 by Goldsworthy Gurney (1793-1875) (Fig. 9). Gurney was a lecturer in chemistry and natural philosophy at the Surrey Institution in London, and he unveiled his device during his final chemistry lecture to the institution. Gurney's blowpipe (Fig. 10) was more compact than previous models and utilized a common reservoir to contain a mixture of oxygen and hydrogen. This flexible reservoir was covered by a wooden cap connected to a platform by metal rods. When weights were placed on the platform, the wooden cap maintained constant pressure on the reservoir as the gas was depleted.[8]

Fig. 9. Goldsworthy Gurney, who invented a safer model of oxy-hydrogen blowpipe. *Wikipedia*

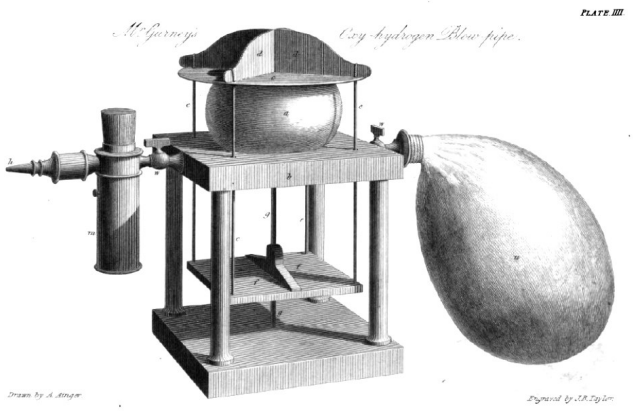


Fig. 10. Goldsworthy Gurney's safety oxy-hydrogen blowpipe. Gas is stored in the bladder at right, which is used to fill the flexible reservoir at the top. The wood cap is connected to a platform by rods. When weights are placed on the platform, a mixture of oxygen and hydrogen is pushed into the blowpipe at left.

Transactions of the Society, Instituted at London, for the Encouragement of Arts, Manufactures, and Commerce, vol. 41 (1823).

Into the Limelight

Scientists experimenting with oxy-hydrogen blowpipes were interested mainly in the heat generated by the blowpipe flame, but a byproduct of the heat applied to certain chemicals was the production of light. This was particularly true when a flame was applied to a stick of lime. Robert Hare mentioned in his initial report of his experiments in 1802 that lime produced the most intense light of any chemical tested, "the splendour of which was insupportable to the naked eye." He recommended the light be viewed through deep-colored glasses.[9]

Other men who witnessed or repeated his experiments, including Priestley and Silliman, also noted this effect. Silliman used almost the same language as Hare in describing the brightness of limelight in a paper delivered to the Connecticut Academy of Arts and Sciences in 1811: "When the compound flame fell upon the lime, the splendor of the light was perfectly inspportable, by the naked eye. . ."[10] Hare also reported that Rubens Peale used the same intrument as Silliman to perform experiments "for the amusement of visitors" at his father's museum in Philadelphia; presumably the visitors were most impressed by the spectacular light effects.[11] In a paper published in 1820, David Brewster suggested that the brilliant light produced by intense heating of lime "might have a most extensive and useful application, both in the arts and in domestic economy."[12]

In 1823, Goldsworthy Gurney went even further in proposing practical uses for limelight: "[The light] from pure lime, is so astonishingly intense and powerful, that it cannot be borne by the eye at all, particularly when under a strong flame from nine to ten inches in length. The light from lime is not unlike daylight in appearance; I am confident that one of our largest theatres might be lighted by it with the most splendid effect; in fact, every other artificial light is thrown into shade before it. However fanciful the idea may be, I cannot help thinking that, at some future time, the light produced in this way from some of the earths, will be used with great advantage in light-houses &c." It seems likely that Gurney demonstrated limelight effects during his lecture, and his biographer cites a member of the audience as reporting that Gurney lit up the theater with limelight. There also is evidence that Gurney used limelight to demonstrate the prismatic colors of light.[13]

In a lecture on the blowpipe delivered to the London Mechanics' Institution in June 1825, John Lewthwaite echoed Gurney's comments, suggesting that if lime could be used successfully for illumination, "the gas lights in use at present would comparatively fade into nothing." Lewthwaite followed in the tradition of other British authors in ignoring the work of Americans Hare and Silliman.[14] That same year, Michael Faraday demonstrated the "limelight effect" at the Royal Institution, using Gurney's oxy-hydrogen blowpipe. Various authors have claimed both Hare and Gurney as the "discoverer" or "inventor" of limelight, but clearly many scientists who had experimented with lime had observed the "limelight effect" (How could they miss it?).[15] However, none of these individuals actually applied limelight to practical illumination, although in the 1830s, Gurney invented the Bude Light, which applied oxygen to an Argand oil lamp flame to increase brightness of the light.

One person who did not view Gurney's suggestion of limelight for lighthouses as "fanciful" was Lt. Thomas Drummond (1797-1840) (Fig. 12). He had seen Faraday's demonstration of the "limelight effect" and immediately began to explore its potential as an illuminant. He experimented with limelight as an illumination source for lighthouses, but ultimately limelight did not catch on for this purpose, partly because of the difficulty of hauling the necessary equipment to distant lighthouse locations. Drummond was more successful in developing a spotlight using limelight illumination, which allowed the light to be seen many miles away. In the 1820s, Drummond was involved with the Royal Engineers in the Ordnance Survey of Ireland. His limelight spotlight enabled light to be transmitted between distant Ordnance Survey stations. His first demonstration of the light was in November 1825, and his description of his experiments was published in 1826. Although Drummond did not adapt limelight for projecting images, he demonstrated practical uses for this type of light, and the names limelight and Drummond light soon became interchangeable in the world of magic lanterns and oxyhydrogen microscopes.[16] The Drummond light even became an attraction in its own right, with itinerant lecturers such as Dionysius Lardner lighting up whole theaters with multiple Drummond lights as part of his regular lecture entertainments.[17]

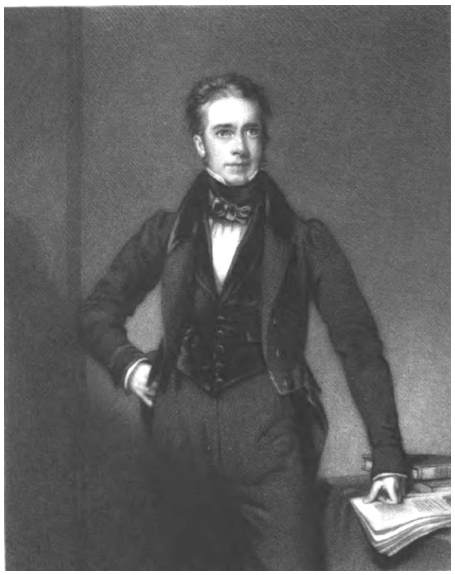


Fig. 12. Thomas Drummond, often credited with the invention of limelight illumination.
http://www.historyireland.com/18th-19th-century-history/larcom-the-cartographer-political-economy-in-pre-famine-ireland/

Limelight as an Illuminant for Projection of Images

In November 1825, the same month in which Drummond conducted his limelight experiments, and a year before his results were published, Dr. George Birkbeck (1776-1841) gave a lecture at the London Mechanics' Institution which seems to be the first documented instance of limelight being used with a projecting microscope and a magic lantern. George Birkbeck (Fig. 13) was originally from Glasgow, but moved to London to take up a medical practice. At the time of this lecture he was the first President of the newly founded London Mechanics' Institution and its principal lecturer.[18] Birkbeck, who lectured on a variety of scientific topics, chose the telescope and the microscope as his subject. He was assisted by two men who made important contributions to the use of limelight in microscopy and magic lantern work. The first was John Thomas Cooper (1790-1854), chemical

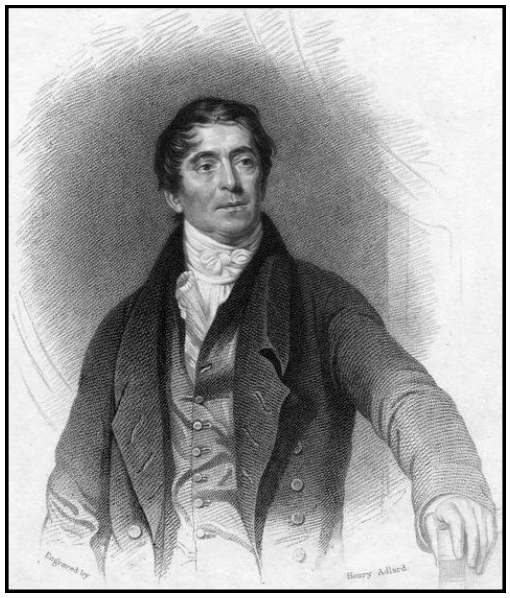


Fig. 13. George Birkbeck, who used limelight to illuminate a magic lantern and a solar microscope in 1825.

New York Public Library

lecturer at the Institution who later teamed with London optician John Cary to manufacture the first commercial oxyhydrogen microsope.[19] The second was Charles Woodward (1789-1877), a scientist and lecturer best known for his work on polarized light.[20]

Birkbeck began his lecture with a discussion of the nature of light. At one point, he used a limelight magic lantern, designed by Woodward, to project light through a prism to produce a color spectrum on a screen:

> I shall even again advert to the subject of *light*, for the purpose of shewing you a very beautiful prismatic appearance, made known to me very conveniently for my purpose, by our excellent Chemical Lecturer, Mr. Cooper, and brought before you by its ingenious inventor, Mr. Woodward.
>
> The object of this invention will be perceived, by attending to an effect formerly made known to you, viz, the power of a prism, or three-sided piece of glass, to separate a ray of light into seven portions, or prismatic colours. We have not at present an opportunity of introducing rays of light from the sun itself [the lecture was in the evening], but we shall find that, by the combustion of calcium, or the metallic base of lime, we can produce an artificial sun, with an evolution of such light as the solar rays are composed of; and, by directing this light through a prism, we shall be able to decompose it into the seven colour-making rays, of which light is constituted.
>
> The Theatre was now completely darkened, to give effect to the beautiful experiment about to be exhibited, and Mr. Cooper stepped forward with Mr. Woodward, to adjust the apparatus alluded to by the worthy President [Birkbeck]. This instrument consists of an application of Mr. Gurney's *oxy-hydrogen blowpipe*, to the combustion of *lime*, for the purpose of producing an intense evolution of light for optical experiments. [At this point, Birbeck referred in a footnote to John Lewthwaite's lecture in the same venue a few months earlier, noting that he specifically mentioned "the vivid intensity of light" produced by limelight.] As soon as the flame, arising from the ignition of the mixed *oxygen* and *hydrogen* gases, was directed upon the *lime* from the jet, its combustion was effected, and the light being directed through the prism attached to the apparatus, a splendid artificial rainbow appeared on the ceiling of the Theatre; exhibiting all the beauty of the natural bow, and displaying the prismatic colors in the same perfection.[21]

The original account of Birkbeck's lecture did not illustrate the apparatus used in this part of the lecture, but it clearly was a marriage of a magic lantern and Gurney's oxy-hydrogen blowpipe. Just such an apparatus was illustrated by Woodward in his 1851 book on polarized light (Fig. 14). In his description, Woodward stated that the apparatus "has long been used by the author, who considers it to possess great power, and to be more convenient for private investigation than any other, while it is equally well adapted for use in the lecture-room."[22]

Earlier, in 1837, Andrew Pritchard (1804-1882), a leading instrument maker and author of many books on microscopy, mentioned Birkbeck's 1825 lecture (although incorrectly giving the date as 1824).[23] He described the apparatus as "a large magic lantern." He also wrote, "I would not omit, however, to mention, that, about the same time, Mr. Woodward instituted some experiments with the phantasmagoria, where the light was obtained in the same way."[24] This does not necessarily mean that Woodward staged phantasmagoria shows—more likely this refers to Philip Carpenter's Improved Phantasmagoria Lantern (Fig. 15), which

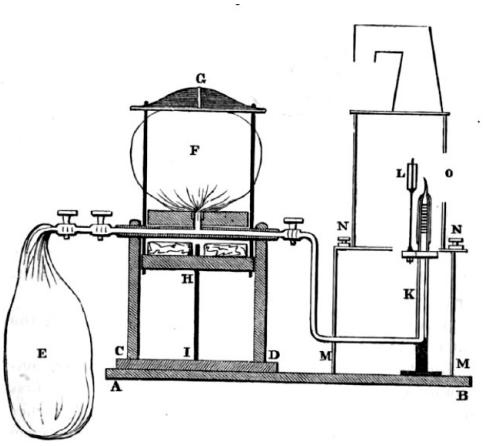


Fig. 14. Charles Woodward's limelight magic lantern, composed of Gurney's oxyhydrogen blowpipe (left) married to Carpenter's Improved Phantasmagoria Lantern. Woodward (1851).

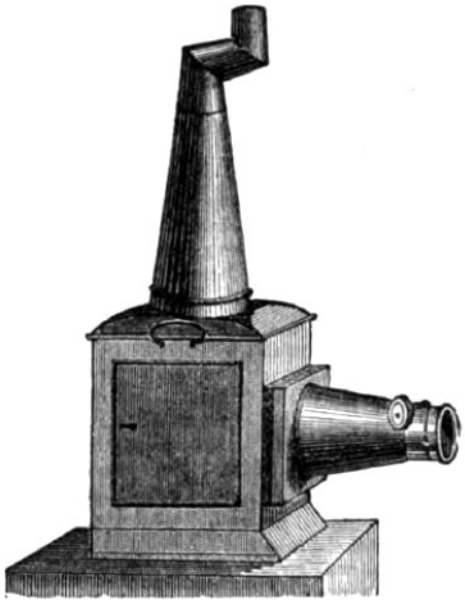


Fig. 15. Carpenter's Improved Phantasmagoria Lantern, probably similar to the one used by Woodward.

Samuel Highley. 1871. Optical instruments—XXII. The magic lantern. *The Technical Educator*, vol. 3, p. 232.

resembles the outline of the lantern in Fig. 15. It is possible that Woodward experimented with a limelight lantern even before 1825. From 1820 to 1823, he lectured on natural philosophy at the Surrey Institution, where Goldsworthy Gurney was the chemistry lecturer. Gurney delivered a lecture on the oxyhydrogen blowpipe in 1823, the same year Woodward gave a course of lectures on pneumatics and electricity. Woodward delivered the very last lecture at the Institution as it was about to close in 1823.[25]

In the section of Birkbeck's lecture dealing with telescopes, he exhibited a view of William Herschel's large reflecting telescope:

> A large and beautiful transparent diagram of this magnificent instrument was here exhibited to the audience, and excited mingled feelings of surprise and approbation. Of this elegant transparency, the engraving, which forms the frontispiece to the present Number, is a correct representation, and we feel much satisfaction in embracing the present opportunity of laying it before our readers [Fig. 16].[26]

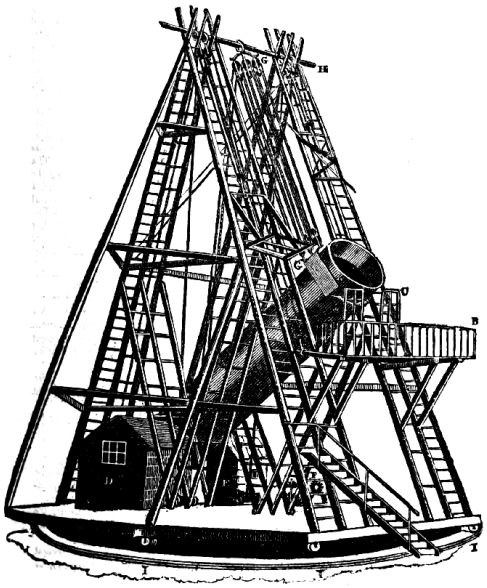


Fig. 16. Engraving of William Herschel's Grand Telescope, used to represent a transparency shown by George Birkbeck in his 1825 lecture on telescopes and microscopes.

The London Mechanics' Register, November 26, 1825, p. 65.

It is hard to tell whether this transparency was projected by a magic lantern or was some sort of large transparent painting, lit from behind. In the early 19th Century, the term "transparency" sometimes referred to magic lantern slides, but sometimes referred to other types of transparencies. Birkbeck himself, in a lecture inaugurating the Institution's new lecture theater in July 1825, described some of

of the equipment in the room: "A large frame, six feet square, for the exhibition of transparent diagrams, was placed behind the lecture table, and was so contrived that it might be raised or lowered, or turned on a spindle to the right and left, so as to afford a complete view of the diagrams to spectators in every part of the room." In the same lecture, Birkbeck referred to a diagram of a mechanism for raising sunken ships: "A handsome transparency, of which the preceding figure is a representation, was now fixed in the diagram frame. . . ." Many of the transparencies in various lectures given by Birkbeck were simple line diagrams, but he also showed images of the Bell Rock lighthouse and even Stonehenge.[27]

Another frequent lecturer, John Wallis, gave many lectures on astronomy both before and after the new lecture theatre was completed. He referred to many astronomical transparencies with motion effects typical of lantern slides available at the time, such as the moon revolving around the earth, motions of the planets, and solar and lunar eclipses, many of which were illustrated in *The London Mechanics' Register* (Fig. 17). If Wallis's transparencies were projected by a magic lantern, the mode of illumination is not known, but presumably he would have had access to the same apparatus as Birkbeck.[28]

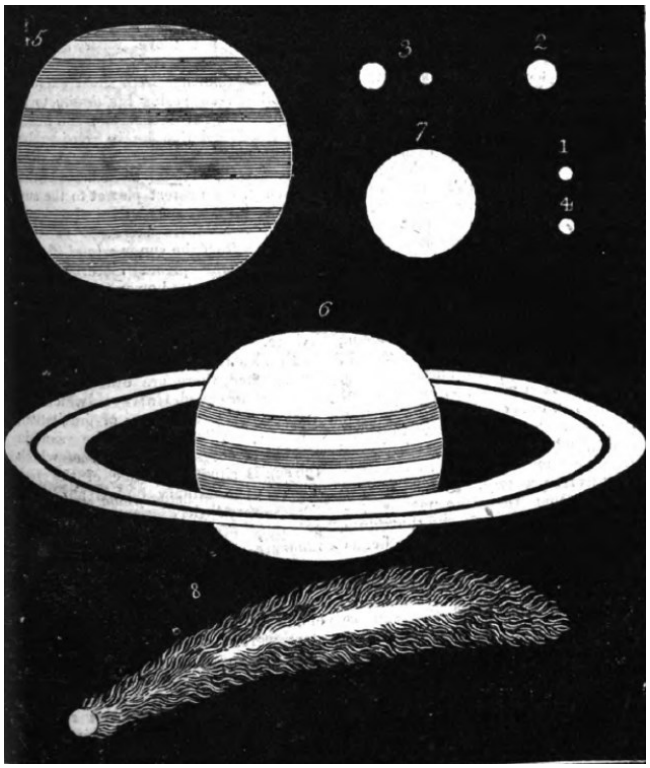


Fig. 17. Woodcut representing a transparency used by John Wallis in his astronomy lectures in 1825. It shows the relative size of planets, as well as a comet.

When Birkbeck turned his attention to the microscope, the high point of the lecture was a demonstration of the solar microscope, but since it was an evening lecture, no sunlight was available, so he turned again to Mr. Gurney's oxy-hydrogen blowpipe:

> The Theatre was again darkened, for the purpose of shewing the operation of the *solar microscope*, by means of the ingenious application of the *oxy-hydrogen blowpipe*, described in the early part of the Lecture. The images of the objects, powerfully illuminated, were thrown upon a screen placed before the apparatus, and the magnitude to which they were enlarged, enabled the spectators to distinguish their most minute parts in the greatest perfection. Specimens of different kinds of wood, such as beech, willow, &c. both branches and roots, were thus exhibited, and the variety observable in the beautiful structure of their fibres, was admirably exemplified. This application of the oxy-hydrogen blowpipe is a striking instance of the power of science, for when the combustion of the mixed gases was first employed for the purpose of producing an intense heat, the instrument could not be used without endangering the life of the operator, though in its improved form, it may be directed to scientific purposes with perfect safety; and for optical experiments, we can produce *a sun of our own*, without waiting for the solar rays, or undergoing the inconvenience occasioned by the lamp connected with the common *lucernal*.[29]

This account of George Birkbeck's 1825 lecture describing the use of limelight for both the magic lantern and the oxyhydrogen microscope, has been periodically rediscovered by various authors, yet Birkbeck's contribution remains largely unnoticed. In addition to Goring and Pritchard's 1837 book, it was mentioned in identical language, including the mistaken 1824 date, in an anonymous 1841 article on the oxy-hydrogen microscope, with an engraving of a current model of the microscope (see Fig. 1). Pritchard's account was quoted verbatim in Simon Henry Gage's 1908 article on the history of the projection microscope. Alerted to Birkbeck's lecture by Pritchard's account, Lindsay Lambert wrote an article on his contribution in 1991 for *The New Magic Lantern Journal*. Most recently, Bob Nuttall, apparently unaware of these previous citations, published an article on Birkbeck's lecture in 2011 for the *Quekett Journal of Microscopy*. Despite the fact that Birkbeck, Cooper, and Woodward actually used limelight for image projection at exactly the same time as the invention of Drummond's limelight spotlight, credit for the dis-

covery of limelight typically goes to Drummond.[30]

Optician and lecturer Edward M. Clarke (see note 5), who designed his own oxyhydrogen microscope, gave the credit to Woodward. In 1842, Clarke wrote, "This brilliant light was first adapted to the illumination of the microscope, by Charles Woodward, Esq., President of the Islington Institution, who (assisted by his friend Mr. Wilkinson of Pall Mall) succeeded in exhibiting transparent objects by its aid, and thus rendered this valuable instrument of philosophical research completely independent of the rays of our uncertain sun. Mr. Woodward has kindly shown me the original instrument, and I am happy in acknowledging that I have derived much valuable information, from his experience, in its management, and his suggestions for improvement. It was (like most other first attempts) of a very rude construction, and liable to many casualties, all which were, however, disregarded by the spirited experimenters in their ardour to prove the main facts of the beauty and efficiency of this mode of illuminating the microscope."[31]

Early Exhibitions of the Oxy-Hydrogen Microscope in London

Once the usefulness of limelight illumination was established, various opticians and scientists worked to design models of the oxyhydrogen microscope suitable for public exhibition. These designs eventually came to resemble modified limelight magic lanterns, which were evolving simultaneously (see Fig. 1). The first to succeed were chemist John Thomas Cooper, who had worked with Birkbeck and Woodward on their demonstration in 1825, and London optician John Cary. They unveiled their oxyhydrogen microscope before a gathering of scientific gentlemen in 1832 and gave their first public demonstration in 1833 at 21 Old Bond Street. They later moved their exhibition to 287 Strand. Daniel Cooper, the son of John Thomas Cooper and editor of *The Microscopic Journal*, gave a detailed account of these developments in 1841, making sure his father was mentioned first:

> The first and most important attempt to develope to the public gaze the microscope on a large scale, was made by Mr. Carpenter, of Regent street, who for many years exhibited a solar microscope, for the gratification of the public. The uncertainty, however, of the weather, and state of atmosphere generally in this country, and more especially in the metropolis, was the great obstacle to this exhibition. This difficulty, at first sight insurmountable, was at length overcome by Mr. J. T. Cooper, who had for many years applied for private purposes, the oxy-hydrogen gases projected on lime, (known generally as the oxy-hydrogen light) as a means of illustrating in his laboratory and lectures, many of the important facts connected with light.
>
> At a meeting of a few scientific friends to witness the results of some experiments with this light, at Mr. Cooper's laboratory, then at the Aldersgate School of Medicine (twelve years since). Mr. Cooper and Mr. John Carey [Cary], of the Strand, feeling assured of the principle and stability of the application, proposed to apply this substitute for the solar rays to the illustration of microscopic power, and accordingly arrangements were made, and a microscope constructed, adapted expressly to the peculiar nature of the light, which, as is well known, differs in many respects from that received from the sun. The first microscope (an experimental one) was opened in the Strand in the year 1832, nearly opposite the end of Norfolk street; this spot was selected on account of the contiguity to Mr Carey's workshops, as a matter of convenience only.
>
> When by dint of much time and experimental application, Messrs. Cooper and Carey had accomplished their labours to their satisfaction, the scientific public it will be remembered, were invited to attend at 21, Old Bond-street, on 18th of February, 1833, to witness the first public exhibition of this kind ever presented, in which the oxy-hydrogen light was made to perform all that had been hitherto effected with direct solar light; and it is but justice too those gentlemen to affirm, that this exhibition was considered to be, both by scientific men and the public at large, not only most creditable to the labours of the projectors, but the most interesting and important that had ever been offered to the public and which could not fail to attract the attention of persons in every age, rank, and station in life;—but possessing the noble aim of enlarging the views of the multitude, by drawing their attention to the wonderful and beautiful adaptations of nature to secure her end. No exhibition was for a period better attended than was this; others in the course of a short time sprang up in various parts of the metropolis and the provinces, and two are even daily exhibited at the galleries of Practical Science in London, forming the leading attraction and exciting the general interest and amusement of those who visit these institutions.

> We have dwelt rather longer on this part of our subject, than it was our intention to do. We shall at all times be advocates for giving "*merit where it is due*," and as we do not find a representation of the above facts in work recently published, expressly on the subject of the "Oxy-hydrogen Microscope" by a Philosophical Instrument Maker, we have considered it but fair to place them on record [this may refer to Andrew Pritchard's treatise published in Goring and Pritchard 1837 (see note 23)].
>
> The application then of the hydro-oxygen light to microscopic purposes, by Messrs. Cooper and Carey in the place of the very uncertain means (solar light) by Mr Carpenter, created at this period a very general taste for microscopic science.[32]

Although Cooper and Cary were, and still are, generally credited with developing the first commercial oxyhydrogen microscope exhibited in 1833, the role of Charles Gould (1786-1849) has often gone unmentioned. He worked for Cary's optical firm, and served as manager for several years. Gould, an expert optician, designed a widely sold pocket compound microscope and a lucernal microscope (see note 29), among many other contributions to microscopy. It was Gould who provided the technical expertise in optics behind Cary and Cooper's oxyhydrogen microscope. He described the microscope in the 1839 edition of his *Companion to the Compound, Oxy-hydrogen and Solar Microscopes made by W. Cary*. Although ignored in most newspaper accounts, he was given credit in an article in *The Tourist*:

> The most astonishing view of these animals, and of the wonders of the microscopic world in general, is presented by a recent improvement in the solar microscope—we refer to Mr. Gould's instrument constructed under the direction of Mr. Cooper and Mr. Carey, the optician,—the extraordinary effect of which is daily exhibited at No. 287 Strand. It acts on the general principle of the solar microscope, but is supplied with an artificial and most brilliant light, produced by the mixture of hydrogen and oxygen gases on lime. The writer had recently an opportunity of witnessing the effect of this extraordinary instrument, and, without describing in detail the beauties or the horrors which it brought to light from the invisible world (in doing which he would be obliged to draw very largely on the faith of his readers), he may give some general idea of the spectacle, by stating that the instrument magnifies three hundred thousand times, so that a drop of water appears to cover a surface of a hundred square feet! We cannot but anticipate some important accessions to physical science from this extraordinary instrument, and we confidently recommend it to the notice of our readers as a source of much instruction and amusement.[33]

Just months after the first public exhibition of Cary and Cooper's microscope, James Holland and Edward Joyce announced a Magnificent Exhibition of Holland and Joyce's Oxyhydrogen Microscope.[34] Their venue at 106 New Bond Street was less than half a mile from the original exhibition at 21 Old Bond Street, and a little over a mile from Cary and Cooper's venue at 287 Strand. Their show was in direct competition with Cary and Cooper's exhibition. Holland and Joyce claimed to have two advantages over Cary and Cooper, improved achromatic lenses and the ability of the microscope to project images of opaque objects. *The Spectator* described their show with an imaginary dialog between the newspaper and the lecturer:

> Suddenly all is dark; and after a while we discern a white disc, eighteen feet in diameter, upon which a light is thrown from small aperture on the other side of the room. An enormous animal, in size beyond that of the elephant Chuny [Fig. 18], appears; and a voice proclaims it to be nothing more than "a common flea, magnified by the Oxy-Hydrogen Microscope, upwards of two million and a half times [Fig. 19]." This is the utmost power ever attained by the microscope; and it is not approached by another instrument of the kind. You perceive that the animal, though but a semi-transparent object, appears perfectly well defined, and in its natural colours. This instrument also is the only one that exhibits opaque objects. The great difficulty as regards them is that the light is reflected from their surface, instead of through the object as is the case with transparent substances. A piece of jewelry, fragments of ore, seeds, &c., are shown in remarkably strong relief, and in their natural colours.
>
> **Spectator**—"This microscope is really achromatic, and so is CARPENTER'S in Regent Street; but the powers of this instrument are so greatly superior to his when he employs the Drummond light." **Lecturer**—"You did not perceive in this microscope of Mr. HOLLAND that prismatic fringe which is observable in the

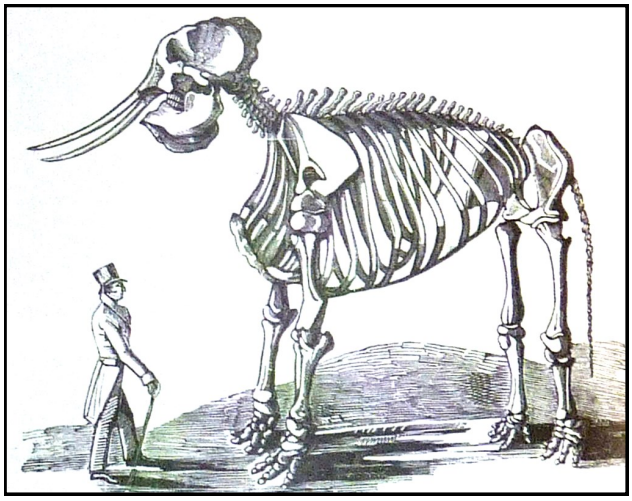


Fig. 18. The skeleton of Chuny (Chuney, Chunee) the elephant. While in a menagerie in London, this elephant was a major attraction, the largest living animal Londoners had ever seen. After his death, his skeleton was in the Museum of the Royal College of Surgeons until destroyed by a German bomb in 1941.

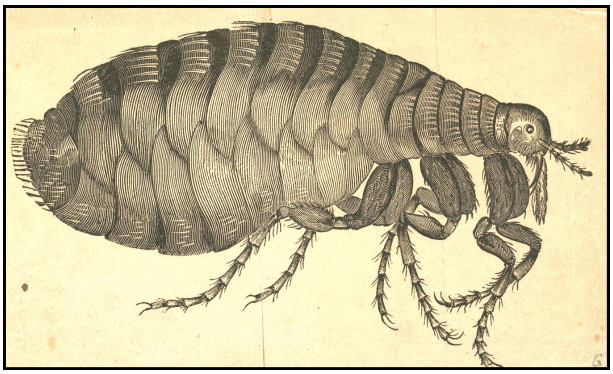


Fig. 19. Highly magnified flea, as seen through a Gould microscope. Science Museum, London.

other Gas Microscope in Old Bond Street; nor have you the disadvantage of waiting, as was often the case when Mr. CARPENTER exhibited his Solar Microscope, for a sufficient quantity of the solar rays. **Spectator**—"This is by far the best, certainly. But one must not forget that CARPENTER was the first who exhibited the Solar Microscope; and that the Gas Microscope in New [Old] Bond Street was the first application of the Drummond light to the purpose of showing transparent objects, as this is the first that has exhibited opaque ones. CARPENTER'S Microcosm, with its Lucernal Microscopes, Kaleidoscopical Camera, Optical Illusions, &c., however is a curious and beautiful exhibition. You will hardly be able to show, by means of the prodigious magnifying power of this instrument, that splendid object the diamond-beetle, which looks like an incrustation of gems [Fig. 20]." **Lecturer**—"As yet, the power of Mr. HOLLAND'S Microscope in opaque objects is scarcely developed. At any rate, this is not only the first, but as yet the only instrument which represents opaque objects highly magnified. That cameo [Fig. 21], which appeared like a colossal bust, nearly eighteen feet high, measured in reality but half an inch."[35]

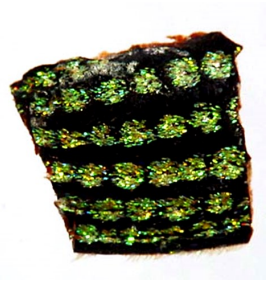


Fig. 20. Above: Brazilian diamond beetle (*Entimus imperialis*), a favorite object projected with the oxyhydrogen microscope. http://www.virtual-beetle.com/images/curculionidae/enthimus/imperia.jpg

Left: Portion of an elytron (wing cover) of a diamond beetle from a 19th century microscope slide. Courtesy of David Walker (http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/artjan15/dw-CaryGould.html).

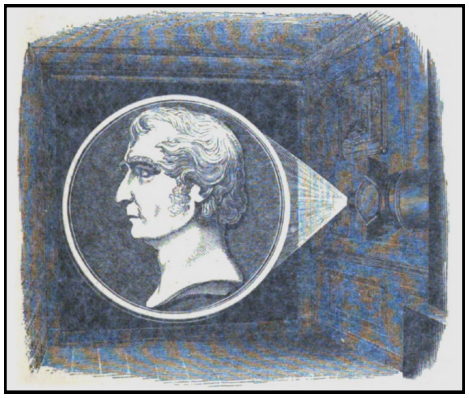


Fig. 21. Cameo of French natural philosopher François Arago (1786-1853) projected with the oxyhydrogen microscope. From E. M. Clarke 1842, p. 61.

The Oxyhydrogen Microscope at the Galleries of Practical Science

The "galleries of Practical Science in London" with daily exhibitions of the oxy-hydrogen microscope, mentioned in Daniel Cooper's article, were the Adelaide Gallery and the Polytechnic Institution. The Adelaide Gallery was the first to purchase one of Cary and Cooper's microscopes. A few years later, the Polytechnic ordered a larger model, also built by Mr. Cary's firm. The Adelaide Gallery's chemistry lecturer, William Maugham, was put in charge of exhibiting the "Grand Oxy-hydrogen Microscope," which was housed in the Microscope Room of the Gallery. He delighted audiences with enormously enlarged fleas, insect wings and eyes, and the microscopic inhabitants of Thames River water. Maugham also demonstrated various chemical experiments, including the melting of platinum with an oxy-hydrogen blowpipe, supposedly of his own design. Back in Philadelphia, Robert Hare once again leapt into action, complaining to the American Philosophical Society that Maugham was ignoring his invention of the oxyhydrogen blowpipe decades earlier.[36]

Maugham, in turn, asserted his own priority regarding another aspect of the oxyhydrogen blowpipe—the production of limelight for the oxyhydrogen microscope. When presented with a silver medal by the Society of Arts for his work on the blowpipe, Maugham's stated in his letter to their journal that he had anticipated the work of Cary and Cooper: "The mode of producing the light upon lime for the oxy-hydrogen microscopes by Cary, Cooper, and others, I was not acquainted with until long after I had obtained the light myself for the proprietors of the Adelaide Street Gallery; I always employed balls of lime, and through Messrs. Cooper and Cary I learnt that cylinders of the same earth are decidedly better. The apparatus which I employed for a microscope commenced by Mr. Tully, is still at the Gallery, and is open to the inspection of any person who wishes to see it. Most likely the last sentence refers to an instrument like the solar engiscope, a modification of a solar microscope, built for Dr. Charles Goring by optician William Tulley (Fig. 22), with Maugham substituting limelight for sunlight.[37]

Another exhibitor of the oxyhydrogen microscope at both the Adelaide Gallery and the Polytechnic was John Frederick Goddard (1795-1866) (Fig. 23). Like Woodward, he was particularly interested in polarized light, and in 1839, he demonstrated a polariscope of his own design adapted for use with Cary's oxyhydrogen microscope. Using limelight, he conducted various experiments with polarized light, and even revealed patterns of polarized light produced

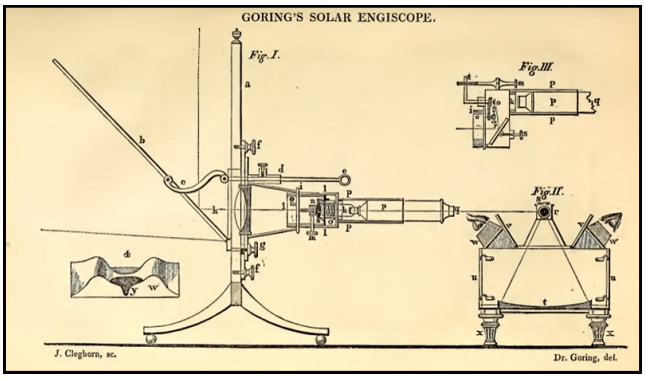


Fig. 22. Solar engiscope designed by William Tulley for Dr. Charles Goring. The instrument combines a solar microscope (left) with a modified camera obscura (right). Sunlight reflected from the mirror passes through the lenses of the microscope. When attached to the camera obscura, the image is reflected onto a white screen (t) of paper or plaster of Paris. Eyepieces on either side allow more than one person to view the image simultaneously. From: Goring & Pritchard 1837, p. 85.

Fig. 23. John Frederick Goddard, who exhibited the oxyhydrogen microscope at the Adelaide Gallery.

by the surface of insects and other animals when illuminated at an angle by limelight. Like John Thomas Cooper (see note 19), Goddard also worked on the early development of photography. In 1841, John Beard, who held the sole license to produce daguerreotypes in England, opened the first British photographic studio at the Polytechnic. Goddard worked with him on improving the photo-sensitive coating on photographic plates and the use of limelight for illumination to shorten the very long exposure time for daguerreotypes: "A bust was then taken by the oxy-hydrogen light in the space of three minutes. The time formerly required by the old process [with sunlight] was about five or six minutes in the middle of the day; but with the more recent improvement of Mr. Goddard (we believe the iodide of bromine) he is enabled to take likenesses in the

space of from two three seconds, to one and a half, to two minutes." In 1842, Goddard began working with George Smith, who opened the first photographic studio in Southampton.[38]

Another key figure in the promotion of the oxyhydrogen microscope was instrument maker Edward M. Clarke; his career has been well covered by others, especially Brian Gee and Jeremy Brooker (see note 5), so only a short summary will be given here. Clarke set up his instrument business in close proximity to the Adelaide Gallery, giving him exposure to those who visited the Gallery. He set up a small theater in his establishment where he could exhibit the oxyhydrogen microscope and other instruments. He marketed his own model of the oxyhydrogen microscope (Fig. 24), which, like many of his instruments, offered relatively minor "improvements" to the work of others. In 1840, he was appointed lecturer at the Adelaide Gallery itself, giving him an opportunity to entertain audiences with the oxyhydrogen microscope and dissolving views while advertising his wares. He even developed his own dissolving view apparatus, the Biscenascope, which used a single light source with a mirror to direct the limelight to one of two projection lenses. Ultimately, this somewhat awkward design could not compete with the double-lantern dissolving view projectors like those used at the Polytechnic, and Clarke soon abandoned this design in favor of a two-lantern system.[39]

Like a number of instrument makers, Clarke published a handbook with directions for use of the oxyhydrogen microscope and his other instruments, which doubled as a catalog for his shop.[40] Although he credited Charles Woodward with the first use of limelight for projection, he also somewhat exaggerated his own contributions, while diminishing those of Cary and Cooper. This led the Polytechnic, which was using a large custom-built Cary microscope, to issue a statement that Cary had learned the secret of limelight "nearly twenty years ago," no doubt from Cooper, which was then "unluckily communicated to Mr. Clarke two years back."[41] Of course, both Woodward and Cooper were involved with George Birkbeck's demonstration of limelight for projection in 1825, "nearly twenty years ago."

While the Adelaide Gallery and the Polytechnic exhibited the oxyhydrogen microscope almost daily for many years, with several different lecturers, other London "Galleries of Practical Science" soon acquired their own oxyhydrogen microscopes. In January 1834, the London Mechanics' Institution presented an exhibition of the Oxy-Hydrogen Microscope by a Mr. Shea, who was claimed as the inventor, along with a demonstration of the Drummond

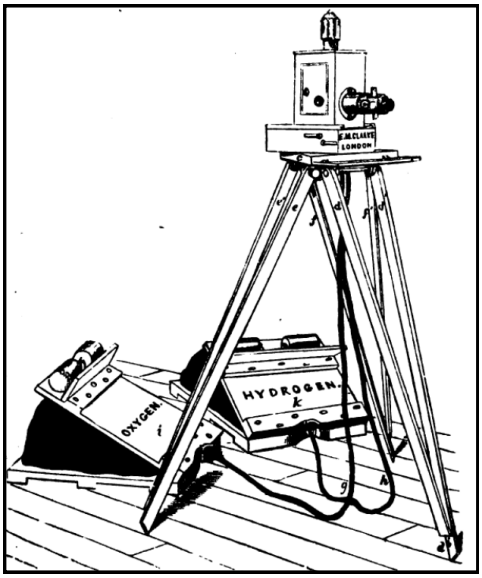


Fig. 24. Edward M. Clarke's oxyhydrogen microscope. From: E. M. Clarke 1842, p. 3.

light. In March 1836, London physician and microscopist Henry Goadby (Fig. 25) lectured at the Royal Institution on insect anatomy, "illustrated by preparations exhibited by the oxy-hydrogen microscope." In April 1848, Goadby lectured at the Royal Polytechnic Institution on the structure and function of insects, illustrated by "a powerful oxy-hydrogen microscope," which may have been the Polytechnic's own instrument. Shortly thereafter, he emigrated to the United States, where he continued to lecture on insects with the oxyhydrogen microscope.[42]

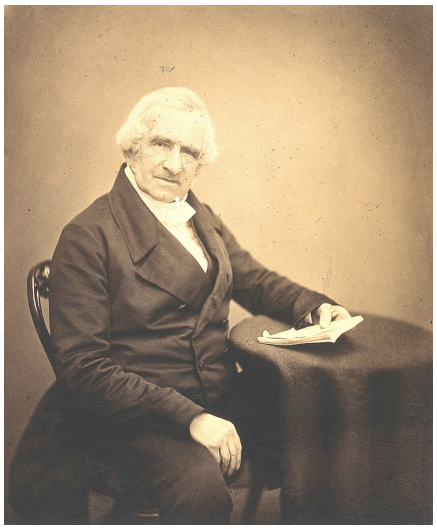


Fig. 25. Dr. Henry Goadby, who lectured with the oxyhydrogen microscope in London and the United States. Wellcome Images.

Provincial Scientific Entertainments

Exhibitions of oxyhydrogen microscopes spread from London venues like the Adelaide Gallery and the Polytechnic Institution to provincial Mechanics' Institutes, exhibitions, and fairs, or were exhibited by itinerant lecturers in a variety of venues. Manchester, being a large city, had a number of venues for exhibiting the oxyhydrogen microscope. A local Italian optician, Joshua Ronchetti (1790-1850), announced an exhibition of an "immensely Magnifying OXY-HYDROGEN MICROSCOPE" at his shop on Market Street in the summer of 1834. Public venues included the Manchester Mechanics' Institution, the Athenaeum, and the Royal Victoria Gallery of Practical Science. At the Royal Victoria Gallery in 1840, the distinguished physicist William Sturgeon (1783-1850) (Fig. 26) lectured on electricity, galvanism, and optics, with a demonstration of the Gallery's own oxyhydrogen microscope. Sturgeon had lectured at the Adelaide Gallery in the 1830s and was appointed Superintendent of the Royal Victoria Gallery in 1840. In December 1843, the Manchester Athenaeum announced a "GRAND TREAT TO THE CHRISTMAS HOLIDAYS," which featured Dissolving Views and the Oxy-Hydrogen Microscope, along with a group of Italian Minstrels.[43]

Fig. 26. Dr. William Sturgeon, who lectured with the oxyhydrogen microscope at the Adelaide Gallery in London and the Royal Victoria Gallery in Manchester.

Smaller provincial cities relied upon visiting lecturers or local talent to exhibit the oxyhydrogen microscope, the magic lantern, the spectroscope, the polariscope, and other instruments. In 1835, a Sheffield teacher, Charles Morton, gave free lectures at the Sheffield Mechanics' Institute, employing an oxyhydrogen microscope made by Francis Chadburn of the same city. In 1840, a powerful oxyhydrogen microscope was exhibited at the Nottingham exhibition, along with a model of York Minster and a circular canal with moving model steamboats, among other curious objects and manufactured goods. The Salford Royal Mechanics' Institution hosted weekly exhibitions of works of art, curiosities, and models, at least one of which included a demonstration of limelight and the oxyhydrogen microscope. Plymouth was fortunate to have a local teacher, electrical engineer, and inventor, Jonathan Nash Hearder (1809-1876) (Fig. 27), who was a frequent lecturer from the 1840s until about 1870. Despite having lost most of his eyesight at an early age, Hearder gave exhibitions with both the magic lantern and oxyhydrogen microscope, along with demonstrations of electrical devices and other instruments. He also gave demonstrations of limelight, dazzling audiences with its brilliance.[44]

Fig. 27. Jonathan Nash Hearder, frequent lecturer with the magic lantern and oxyhydrogen microscope in Plymouth. Lee-Ann Hearder.

Irish Eyes on the Screen

The oxyhydrogen microscope came to Ireland as early as 1834. In 1838, the Royal Dublin Society began supplementing its in-house lectures by sending its own lecturers into provincial cities and towns to give public talks on science. One of the most popular lecturers of the 1840s and 1850s was a local surgeon, William Lover (1801-1864). In 1842, he published a textbook for school students entitled *Facts in Chemistry*. In his discussion of hydrogen, he noted that "It is extensively used with oxygen . . . in the *oxy-hydrogen blow-pipe*, and the *oxy-hydrogen microscope*: in the first, to obtain such an intense heat as to melt the most refractory bodies; and in the second, to procure a light, with the assistance of lime, which is intolerable to the eye." Lover obtained his own oxyhydrogen microscope, designed and built by a prominent local optician, Thomas Grubb (1800-1878) (Fig. 28), best known for his outstanding telescopes.

Fig. 28. Thomas Grubb, Dublin instrument maker who supplied an oxyhydrogen microscope for Irish lecturer William Lover. *Wikipedia*

An 1851 ad in the *Waterford News* announced a "Course of Six Lectures on Animal Physiology, in Connection with Zoology, and the Physical Constitution of Man," illustrated by "Mr. Lover's Painting on Glass, Magnified by the Double Oxy-Hydrogen Microscope" (probably a combination of an oxyhydrogen microscope and a magic lantern). An 1854 ad in the same newspaper announced a lecture on vision and the eye, also using the Oxy-Hydrogen Microscope. For nearly 20 years, Lover exhibited the oxyhydrogen microscope and the limelight magic lantern throughout Ireland, until he was disabled by a stroke in 1859. In this devoutly religious country, his lectures took on a religious tone, with references to the microscope revealing the Wonders of Creation, a view in line with the Natural Theology of that period. He became so closely associated with the oxyhydrogen microscope that he was nicknamed "Oxy-Lover." He had other interests as well. He was a champion of steam power, and he often performed electrical demonstrations in his lectures. He also worked as a medical illustrator, drawing images on stone for lithographic plates in medical texts.[45]

Usually the oxyhydrogen microscope was exhibited alongside magic lanterns, electrical devices, working model steam engines, and other devices. However, an unusual pairing occurred when musician Giulio Regondi toured Ireland with a guitar and concertina in 1834 and 1835. During intervals between musical selections, James Holland of London exhibited his Achromatic Oxy-Hydrogen New Ionian Microscope, which enabled the audience to view creatures in a drop of water magnified 900,000 times, and "an insect magnified so as to render it in appearance a Leviathan." Holland also demonstrated the limelight's powerful illumination.[46]

To India and Beyond

The oxyhydrogen microscope soon spread to Britain's overseas colonies. As early as 1834, surgeon W. T. Stevenson published *A Companion to the Oxy-Hydrogen Microscope, Being a Description of Some of the Living Animals as Shewn by that Instrument now Exhibiting at Calcutta*. In the introduction to his book, Stevenson described the microscope in glowing terms:

> The perfection and use of an instrument possessing such gigantic powers as the Oxy-Hydrogen Microscope, will be likely to form a new era in science. By its means thousands of minute species of animated nature hitherto unknown and unseen may be made apparent and exhibited on a scale unparalleled in magnitude. Species, too, of the most extraordinary form, economy, and description. This instrument is an application of the light which has been so successfully employed by Lieutenant Drummond. . . . The light is produced by the combination of oxygen and hydrogen in a state of combustion, projected upon a mass of lime, which by peculiar machinery is made to change constantly its position and present a new surface to the inflamed gases. This light is of extraordinary brilliancy and power: its intensity is so great that the retina cannot bear its influence with impunity for any lengthened period.[47]

The oxyhydrogen microscope reached Australia and New Zealand at least by the 1840s. In the late 1840s, daguerreotypist and magic lanternist J. W. Newland included the oxyhydrogen microscope in his magic lantern shows. Newland was at the Royal Victoria Theatre in Sydney in May and June 1848, where his exhibition of the oxyhydrogen microscope, dissolving views, chromatropes, and the Drummond light, was oddly paired with Mr. J. P. Hydes, "Congo Minstrel and successful Delineator of Negro Eccentricities." The latter offered "a variety of Ethiopian Melodies, with the Congo Bone Castanet Accompaniment." Newland also appeared at the School of Arts in Sydney in early June, minus the blackface minstrel show. The oxyhydrogen microscope was a regular feature along with dissolving views, chromatropes, and music at Spencer's Royal Polytechnic in Sydney, which opened in 1854. In the 1860s, chemist and lanternist H. T. Watts was giving scientific lectures in Auckland, New Zealand and exhibited the oxyhydrogen microscope, including in his lectures crowd-pleasing views of animals in a drop of water. In the 1870s and

and 1880s, Royal Polytechnic lecturer John Henry Pepper, on a tour of English-speaking countries, included the oxyhydrogen microscope with his usual array of dissolving views and ghost effects.[48]

The Oxyhydrogen Microscope Comes to America

The first notice of an oxyhydrogen microscope arriving in the United States was a short advertisement in a New York paper that managed to get the name of the manufacturer wrong. This ad ran many times in the New York *American* from November 21 to December 31, 1834:

> Just arrived from London, and now exhibiting at the large rooms, 108 Broadway, corner of Pine street—hours of exhibition from 3 to 10 P.M.—admission 25 cents—PERRY [CARY] AND COOPER'S ORIGINAL GRAND HYDRO -OXYGEN MICROSCOPE; unrivalled for the brilliancy of its light, the splendor and variety of its objects, and its great magnifying powers. This instrument is a recent invention, and is considered the *chef d'oevre* of the optical and chemical sciences. It has been visited in London and other cities of Great Britain by upwards of 300,000 persons, and is now for the first time for the inspection of the American public. Exhibition of Living Aquatic Insects every evening.[49]

Probably this first exhibition was presented by a Dr. Weldon, who exhibited his Original Grand Hydro-Oxygen Microscope at Scudder's American Museum in New York (Fig. 29) in 1835 and 1836. The *New York Commercial Advertiser* described the exhibition in dramatic terms:

> In the American Museum, in N.Y., the force of its other well-known and manifold attractions is swallowed up in that of the marvelous Hydro-Oxygen Microscope, which there nightly exhibits its world of wonders to an astonished, and we add, terror-stricken crowd. . . . So amazing is the magnifying power of this microscope, that it can optically increase the size of objects from 14,000 to 6,000,000 of times. It can make the finest cambric seem as if woven with cables and increase the wing of a fly to the dimensions of 150 feet [a considerable exaggeration, considering most screens were about 20 feet wide!]. . . . The skeleton larvae of the gnat—almost invisible to the naked eye—is here magnified to a size it can barely take in—exhibiting through the transparent texture of the insect's body, the circulation of the blood, the action of the muscles, and its whole internal economy. A bed-bug is rendered a hideous and digesting monster of more than 30 feet long—a flea, larger than an elephant, looks a far more formidable dragon than any overcome by St. George; a piece of the finest lace looks like nothing so much as the rough lattice work of a vineyard; and the eye of a common fly as eight feet long, exhibiting a remarkable structure of a thousand different orbs of vision studding the surface. . . .
>
> But the most remarkable of all, and that which elicits most of our astonishment and surprize, is the appearance of a single drop of pure water, which absolutely seems a pond, filled to repletion with the most hideous and ravenous monsters, disporting in every restless activity, and their forms of motion developed as clearly as on a naturalist's engraving. Prominent among them is the great Hydrophilus or Water Devil [see back cover], the shark of this mimic ocean, which every days consumes eight times its own weight of insects [Here the language becomes preposterously exaggerated, since a *Hydrophilus* beetle larva cannot live in a single drop of water, and does not eat eight times in own weight each day]. These animals, at times, engage in a contest of ap-

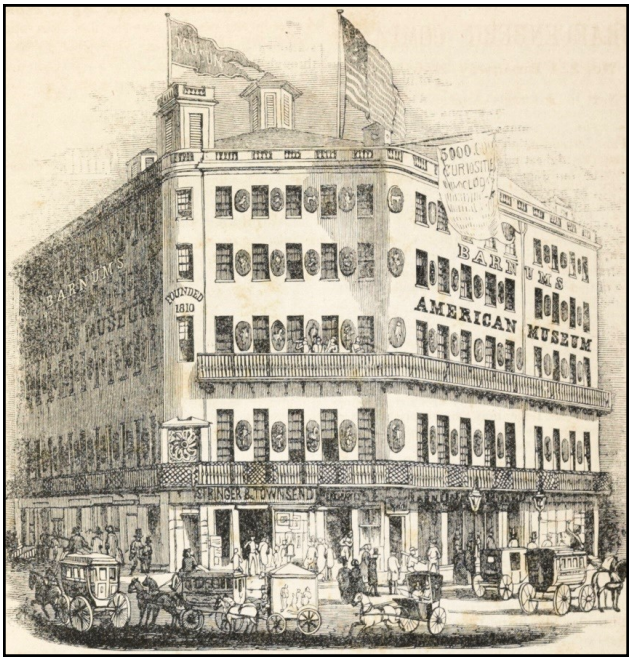


Fig. 29. The American Museum in New York. The museum was run by John Scudder until 1841, when it was purchased by P. T. Barnum.

> parently frightful animosity, and again play themselves as if actuated with the most boundless enjoyment. Who that looks at a vase of clear and pure water ere he puts it to his thirsty and anxious lips, could imagine the world of jarring interests he is consigning to his stomach?—We have known a lady who, as far as fear of water goes, has been afflicted with hydrophobia ever since she saw it.[50]

In April 1836, Dr. Weldon appeared at Mechanics' Hall in Alexandria, Virginia, with the same microscope. Again, the announcement contains the usual Barnumesque language and exaggerated measurements, although in this case the images were said to be projected on a white disc of only 200 square feet (16 feet in diameter):

> Among the many beautiful specimens presented will be a single drop of water, magnified 2,500,000 times, discovering myriads of living beings in full activity, which present themselves in all their seeming gigantic proportions and really terrible conformations. Also, the Skeleton Larvae of the Gnat, discovering its whole internal structure, particularly the lungs, heart, and the passage of the blood vessels [Insects do not have lungs, blood, or blood vessels; they breathe through tiny tubes called tracheae and hemolymph flows throughout the body].
>
> The Eye of a Fly will be seen 12 feet in diameter, and the Wing about 200 feet in length. The Sting of the Honey Bee about 8 feet and the Tongue about 7 feet in length. The teeth of a Fly will be distinctly seen about 4½ feet in length [Flies do not have teeth]. The Chintz or Bed Bug will be magnified 50 feet in length, and the common Flea larger than an *Elephant*. . . .
>
> The last scene is a magnified combination of living aquatic insects. Their peculiar habits may be distinctly observed, some the size of Crocodiles, seizing and devouring their prey, some fighting with the greatest ferocity, and others sporting among their subaqueous groves. The whole scene warms with life and produces upon the mind of the beholder astonishment at the wonders of the Microscopic World.

Weldon later spent the entire month of January 1837 exhibiting the microscope at the Louisville Museum in Louisville, Kentucky. In late February, he was back in New York, lecturing with the microscope at the Mechanics' Institute of the City of New York.[51]

In April 1835, a hydro-oxygen microscope was exhibited at the Museum in Albany, New York. The newspaper announcement gives few details. At the time of writing this article, an antique map and print dealer was displaying a handbill for the "Hydro-Oxygen Microscope" at the Albany museum in which the wording and order of presentation of specimens is very similar to the New York City account, suggesting it may have been the same microscope.[52]

In August 1835, "Dixon & Reed's Oxy-Hydrogen Microscope with a Magnifying Power of 6,000,000!!!" was announced at Mechanics' Hall in Lowell, Massachusetts. The fact that it was called an oxy-hydrogen microscope instead of hydro-oxygen suggests it may have been a different instrument, but the identities of the exhibitors are unknown.[53]

A "Hydro-Oxygen-Microscope" was announced at Rembrandt Peale's Museum in Baltimore in October 1835. The same sorts of specimens are mentioned, including a "bed bug magnified to the extent of 60 feet, a flea to 20 feet, the eye of a fly to 18 feet and the wing to 300 feet long." The larvae of mosquitos and gnats also are mentioned, as are pieces of lace and cambric. As usual, many of the dimensions are exaggerated. The objects were projected on a disc of white canvas with an area of 400 square feet, which is only about 23 feet in diameter.[54]

A Hydro-Oxygen Microscope appeared in New Haven, Connecticut in the summer of 1836, exhibited by a Dr. Frisbie, said to be the inventor of the device. The *Connecticut Herald* announced its arrival in town:

> The exhibition of this splendid production of *American* ingenuity . . . will take place each day for several days at the Hall, corner of Chapel and Orange sts., opposite the New Haven Bank. The magnifying power of this instrument produces the most astonishing developments, not only to the eye of the philosophical inquirer, but to every observer of animated nature. The common mind can hardly conceive that a single drop of water is a most magnificent object, containing a world of beings of the most singular hue and form, presenting a scene of busy life, as active as that of the green babel upon which we move. Yet it is so presented to us, while the minutest objects, of every species and character, are made hideous or pleasing by their vast dimensions.[55]

The *Columbian Register* added a bit more detail:

> *The Hydro-Oxygen Microscope, invented by Dr. Frisbie*, and now exhibiting at Saunder's Hall, Smith's building, corner of Chapel and Orange sts., is one of the greatest curiosities with which our city has been visited. This unrivalled instrument reveals to our astonished eyes the beauties and perfections of the minute works of the great Creator; such as, a single drop of water magnified 2,500,000 times! occupying the surface of a disc of 230 square feet [17 feet in diameter], and teeming with living insects and animalcula; showing eels in vinegar [actually nematode worms, *Turbatrix aceti*, which feed on the microbial cultures used to make vinegar], mites in figs, crystallizations, &c."[56]

Other lecturers of the late 1830s brought the oxyhydrogen microscope to various parts of the country from New York to Mississippi. In December 1836, Rubens Peale's Museum in New York announced the Grand Achromatic Hydro-Oxygen Microscope, which would reveal the "hidden portions of creation." In April 1837, William J. and Henry Hanington of the "Dioramic Institute, City Saloon" announced a mixed program at a new facility they called the Brooklyn Institute. In addition to Hanington's Grand Hydro-Oxygen Microscope, there were Moving Dioramas, an Italian Pantomime, German Minstrels, the Automaton Minstrel, and Afong Moy, the Chinese Lady, singing in Chinese. Hanington's Hydro-Oxygen Microscope was a regular attraction at their Dioramic Institute on Broadway in New York, with showings advertised in May and July 1837, with a similar assortment of other acts and attractions.

Peale's Museum in Philadelphia featured Dr. Robert Hanham Collyer (Fig. 30) and his Grand Achromatic Hydro-Oxygen Microscope in May 1837 (the same one exhibited earlier at Peale's Museum in New York). This microscope was claimed to magnify objects 8 million times. It was also claimed that "in a single drop of water are seen myriads of living creatures, displaying all their natural habits and ferocity, being frequently observed in the act of destroying and devouring one another."

In June 1838, Herr Schmidt & Co. appeared at the Saloon of the Mississippi Hotel in Natchez, Mississippi. The program included a Grand Hydro-Oxygen Microscope, Panoramic Views or Dissolvent Tableaux, mechanical Fireworks, and other attractions.[56a]

Fig. 30. Robert Collyer, who exhibited the oxyhydrogen microscope at Peale Museums in New York and Philadelphia in 1836 and 1837.

https://www.eapoe.org/people/collyerh.htm

The Oxyhydrogen Microscope in the 1840s. In the 1830s and 1840s, the United States generally lacked established institutions like the Adelaide Gallery and the Polytechnic, which could hire their own lecturers, so the microscope was more likely to be exhibited by traveling lectures. One of the most prolific lecturers was Dionysius Lardner, a British lecturer who toured the United States from 1842 to 1844. He incorporated the oxyhydrogen microscope into many of his lectures, but it never was at the head of the bill. Usually it appeared somewhere from the middle to the end of an announcement, among lectures on astronomy, light, steam, etc., illustrated with magic lantern slides, moving panoramas, dissolving views, and scientific experiments.

Lardner had lectured in London and the provinces for many years, was familiar with all the major lecture venues, and knew many of the men involved in perfecting the oxyhydrogen microscope. He had at least two such microscopes in America, the second having been imported from Cary's optical firm in 1844. In June 1844, Lardner gave a lecture at the National Theatre in Philadelphia on "The Solar or Gas Microscope," in which he demonstrated Cary's instrument. Sometimes lectures with the oxyhydrogen microscope were given by Lardner's assistant and projectionist, Robert Grant, who presumably used Lardner's equipment. When exhibiting Lardner's show at the Apollo Hall in Washington, Grant followed a performance of the Original Virginia Minstrels.[57]

In November 1844, about a month after Lardner's new oxyhydrogen microscope was destroyed in a fire in Providence, Rhode Island, a different microscope, described as the Monster Gas Microscope, appeared in Philadelphia, exhibited by a Mr. Keevil at Peale's Museum. Keevil followed Lardner's style in giving a series of lectures on astronomy and polarized light, with the oxyhydrogen microscope as an add-on each night, along with Dioramic Views and "a splendid

collection of Chinese Fireworks." In December, Keevil appeared with the same program at the Assembly Rooms in Baltimore.

The Hydro-Oxygen Microscope was a regular feature at Barnum's American Museum in New York in the 1840s, along with dissolving views, chromatropes, laughing gas, a petrified human body, a live orangutan, a wax figure of Queen Victoria, and a variety of singers, comedians, and other performers. In 1847 and 1848, Mr. J. K. Kennedy, possibly a Pittsburgh businessman, exhibited an oxyhydrogen microscope in several western and southern cities, often partnered with John H. Lillie, an inventor of an electro-magnetic engine. They appear to have traveled down the Ohio and Mississippi Rivers, appearing successively in Pittsburgh, Cincinnati, New Orleans, and Jackson and Vicksburg MS. They exhibited the Drummond light, the oxyhydrogen microscope, Morse's telegraph, Lillie's motor, and a circular model railroad powered by an electric motor.[58]

Gabor Naphegyi's Short Lecturing Career. Exhibitions of the oxyhydrogen microscope were very popular in the 1850s. One of the most colorful individuals to exhibit the oxyhydrogen microscope in this period was a man who called himself by the Hungarian name Gabor Naphegyi, although he was not Hungarian, but Bohemian, and his real name was Sonnenberg. In reality, he was an extremely successful con man who circulated among the cream of society and owned a splendidly furnished mansion in New York complete with a conservatory filled with exotic plants. He turned up in all sorts of places from New York and Washington to Bastrop, Texas; New Orleans; St. Louis; Mexico; Venezuela; and the Virgin Islands.

Naphegyi had a habit of ingratiating himself with powerful men, including the President of the United States and other Washington politicians; the French Emperor Maximillian of Mexico; the President of Venezuela; and the former President of Mexico, Antonio López de Santa Anna. At various times, he claimed to be the son of the Egyptian ambassador, a chemistry professor at a Hungarian university, a professor of languages at the University of Texas, a physician in the Hungarian army, the secretary of Hungarian revolutionary patriot, Lajos Kossuth (who said he knew nothing about him), the Washington representative of Santa Anna when the old man was trying to regain power in Mexico, an adventurous traveler in the Arab world, and an expert on dozens of languages. He used various titles, including Mr., Dr., and Col. Naphegyi. For several decades after arriving in the United States in 1849, he was charged with plagiarism, forgery, swindling various people out of their money, failure to pay bills, writing bad checks, and other offenses. He was arrested multiple times, but usually managed to wriggle out of the charges. His exploits were well chronicled in the newspapers, which described him as a swindler, con man, and humbug, yet he made himself wealthy and continued to circulate in high society. About the only time he seems to have made an honest living, of sorts, is when he persuaded Emperor Maximillian of Mexico to give him a contract to design and build the gas works for the city of Veracruz.[59]

How Mr. Naphegyi came to be a showman exhibiting magic lantern slides and the oxyhydrogen microscope is a mystery, but he often had at least pretended to have an interest in science. In May 1851, he turned up in Toronto, identifying himself as a professor at the university in Pesth, Hungary, and seeking an appointment as professor of botany and chemistry at the University of Toronto. Since he had no documents attesting to his qualifications, the university convened a committee to examine his knowledge. Botany professors submitted a series of relatively simple questions, which Naphegyi chose to answer in German because of his "imperfect acquaintance with the English language," despite claiming to be an expert on languages.

Based on his answers, the committee concluded that "no benefit could result from the employment of Doctor Naphegyi's services in the department of Botany."[60] As for chemistry, *The New York Times* years later wrote about his misadventures in Toronto and stated that, "His weakness or his strength was chemistry, about which, it turned out, he knew enough to enable him, if he chose, to blow up half the college buildings."[61] Apparently undeterred by the committee's skeptical view of his scientific credentials, Naphegyi further claimed to have invented the hyalotype process, the procedure for making positive photographs on glass for lantern slides and stereoscopic views. The committee, however, credited "Messieurs Larghim [Langenheim] of Philadelphia" with the invention and pointed out that Naphegyi himself had stated that he had exhibited "slides made by those Gentlemen" in his lectures.[62]

Naphegyi's short lecturing career got off to an inauspicious start shortly after arriving in the United States via New Orleans in 1849. According to a San Antonio newspaper, writing of his exploits nearly 20 years later, Naphegyi soon left New Orleans. Apparently, "the police were at his heels" for swindling people by selling tickets to a fake raffle for a piece of his own artwork. On his way out of town, he stole gold from a Catholic priest. Finding his way to St. Louis,

he was the guest of "banker Mandelbaum" and "protégé of Drs. Pollak, Pope and Prout." These men were just the sort of individuals Naphegyi would latch onto for years—prominent men with money. While in St. Louis, he tried unsuccessfully to begin a public lecturing career. "Having failed in his efforts to exhibit a hydro-oxygen gas microscope and a solar microscope, and after involving the Convent of St. Francis Xavier, the Female Seminary of the Sacred Heart, and a number of private gentlemen in heavy loss, he suddenly disappeared."[63]

In January 1850, Naphegyi "located himself at Georgetown [Washington DC], in connexion with the College there, and is devoting his really brilliant talents to the natural sciences." On January 7, he gave a lecture to the faculty, and all present were said to be delighted with his experiments. Among the apparatus he claimed to have procured from London was "a Drummond Light Microscope, which magnifies objects in the most astonishing and brilliant manner."[64] A week later, Naphegyi gave a public lecture with the Drummond Light Microscope, magic lantern slides, and dissolving views at Carusi's Saloon in Washington (Fig. 31). The program was fairly elaborate, with subjects from crystallography, anatomy, zoology, botany, and astronomy, as well as dissolving views of Hungary and Turkey. All of this was accompanied by music from Joseph Kessler, a pianist from Vienna.

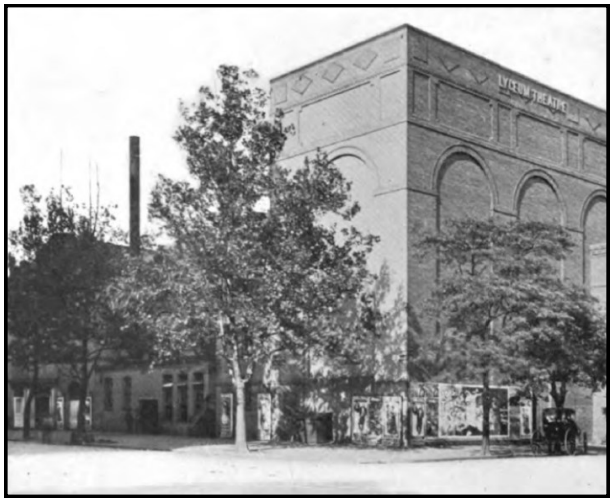


Fig. 31. In 1850, this building in Washington housed Carusi's Saloon, a major music hall, dance hall, theater, and meeting site. It changed names many times and was called the Lyceum Theater when this photograph was taken around 1903. The lower level once housed the city's post office.

Madison Davis. 1903. A history of the city post-office. *Records of the Columbia Historical Society* 6:143-213.

On January 1, 1851, Naphegyi brought his magic lantern show and exhibition of the oxyhydrogen microscope to Baltimore's Washington University (a medical college). The program was much the same, although the lantern slides, which he called HYELOTYPIC OBJECTS, included the Battle of Bunker Hill, Washington delivering his inaugural address, and portraits of Presidents Jackson, Polk, Taylor, and Fillmore, plus General Winfield Scott and Hungarian Revolutionary Kossuth. The program concluded with dissolving views of the accidental burning of the U.S. Steamship Missouri at Gibraltar (Fig. 32), scenes of moving ships, Pyramic Fires (chromatropes), and the Microscopic Kaleidoscope.

In late January and early February 1851, Naphegyi appeared again in Baltimore at Masonic Hall, under the sponsorship of the St. Vincent de Paul's Library Association. The Baltimore paper announced that "the distinguished Hungarian exile" would "give a course of Instructive and Scientific Lectures," which included a similar assortment of microscopic views and dissolving views. This is the last record I have found so far of his exhibiting the oxyhydrogen microscope or magic lantern.[65]

Fig. 32. The burning of the steamship *Missouri* at Gibraltar in 1843. Naphegyi included dissolving views of this scene in some of his lectures.

Wikimedia Commons

Mr. Whipple's Oxyhydrogen Microscope. A far more respectable lecturer with the oxyhydrogen microscope in the 1850s was pioneering Boston photographer John Adams Whipple (1822-1891) (Fig. 33). Among his many achievements, Whipple was one of the first to make daguerreotypes of the moon through a telescope, and the first to make daguerreotypes of microscopic objects through a microscope. In the ear-

Fig. 33. John Adams Whipple, pioneer Boston photographer who exhibited dissolving views and the oxyhydrogen microscope during the 1850s.

"John A. Whipple and the Daguerrean Art," *Photographic Art-Journal*, August 1851, pp. 94-95.

ly 1850s, Whipple travelled throughout the Northeast, as far south as Baltimore and Washington, presenting exhibitions of dissolving views, most of which included demonstrations of the oxyhydrogen microscope. Whipple initially presented his shows at his Daguerreotype Rooms, but the crowds soon outgrew that space and he moved to Boston's Melodeon. On February 18, 1850, he presented a show that not only included a variety of dissolving views, but also an oxyhydrogen microscope that would reveal "the population of the Cochituate drop" (Cochituate Lake was a reservoir that supplied Boston's water).

The show remained at the Melodeon until mid-May 1850, and accounts of the exhibition became increasingly detailed. A Worcester paper, reporting on the Boston exhibition, stated that "The lens of the oxyhydrogen microscope is the largest and best ever imported for that purpose, and it effect is wonderful. A great difficulty in this kind of microscope, heretofore, is that it very quickly destroyed life in the more minute and delicate animalculae subjected to its action. But by a new invention, which separates the heat from the light, this difficulty is remedied, and the beholder is able, for some time, to view the antics of these minute beings under the immense magnifying power of this splendid instrument."[66]

Various ads and articles about Whipple's exhibitions never made any argument for the educational value of the shows—they were intended to be pure entertainment. The oxyhydrogen microscope was not claimed to be a way to learn about biology, but rather to observe the "antics" of microscopic organisms. One Boston paper reported that the "new Microscope is a whole book of revelations, and very amusing ones, to judge by the peals of laughter that greet every new tribe of aboriginals from the vast universe of littleness." Nevertheless, some writers were eager to distinguish Whipple's instruments from a mere "tin toy" magic lantern: "Whipple's instruments are supplied with large and expensive achromatic lenses from one of the most celebrated opticians in Germany, and unequalled by anything of the kind in the world, except the similar instruments in the Royal Polytechnic Institution in London."[67]

After completing his run at the Melodeon, Whipple's show went on the road, visiting major cities in the Northeast, including Worcester, New Bedford, Salem, Fall River, Springfield, and Pittsfield MA; Hartford and New London CT; Providence and Newport RI; Portsmouth NH; Portland ME; and Philadelphia PA. When he was at Liberty Hall in New Bedford, he demonstrated the power of the Drummond light from the cupola of the Hall (Fig. 34).

Fig. 34. Liberty Hall in New Bedford, Massachusetts. When Whipple brought his exhibition of dissolving views and the oxyhydrogen microscope to town, he demonstrated a powerful Drummond light from the cupola of the building.

https://www.whalingmuseum.org/new-bedford-lyceum-history/

In September and October 1850, Whipple's Dissolving Views were back in Boston, this time at Tremont Temple. For the Christmas holiday season, Whipple was at Odd Fellows' Hall in Washington, where he put on an elaborate show of dissolving views, the oxyhydrogen microscope, European views, pyramic fires (chromatropes), and a miscellaneous assortment of slides such as Gen. Zachary Taylor riding a horse, a portrait the "Swedish nightingale" Jenny Lind, and motion slides of ships at sea.

Whipple remained in Washington through January 1851 and then moved on to the Saloon of Temperance Hall in Baltimore (here the word Saloon refers to a meeting hall, not a drinking establishment). By April 1851, Whipple's show was back in New England, exhibiting at Mechanic Hall in Salem, Massachusetts. At this point, the road show was being presented by Whipple's partner, William B. Jones, while Whipple attended to his photographic business. An ad in the Salem paper described the objects shown by the oxyhydrogen microscope, essentially the same as those shown by other exhibitors: "the sting of the Honey Bee, four or five feet in length; the eye of a fly, three or more feet in diameter, shown to consist of thousands of smaller eyes, and a number of other objects, magnified in proportion, with a variety of minute living animals, moving upon the screen in full view of the audience, exciting immoderate laughter by their erratic movements."[68]

Jones continued touring with Whipple's Dissolving Views in New England in 1851 and 1852, appearing in Portsmouth, New Hampshire in May 1851; at Libby's Hall in Portland Maine in June; Aborn Hall in New London, Connecticut in January 1852; Springfield, Northampton, and Greenfield, Massachusetts in February 1852; and Pittsfield, Massachusetts in March 1852. In 1853, Whipple's show, apparently under new management, moved westward, appearing in Buffalo, New York in January; Cleveland, Akron, and Ravenna, Ohio in March; and Pittsburgh, Pennsylvania in April. The program included the usual array of dissolving views and other lantern slides, chromatropes, the oxyhydrogen microscope, and demonstrations of the Drummond light.

However, the show had acquired the name Whipple's Grand Exhibition of **Chemical** Dissolving Views. The show's appearances seem to have become more sporadic after that. In December 1854 and January 1855, Whipple's Chemical Dissolving Views appeared at Townsend Hall in Buffalo, New York, with the full range of dissolving views, travel slides, moving slides, Chromotypes or Artificial Fire Works, the oxyhydrogen microscope, and even a demonstration of the oxy-hydrogen blowpipe. The last newspaper announcement of "whipples Chemical Dissolving Views" that I have found is for an appearance in Hillsdale, Michigan in August 1859 in Waldron Hall, a building best known as the site of Sister Ellen G. White's religious vision in 1857. In the ten years that Whipple's Dissolving Views were on tour, the program seems to have changed very little besides periodic introduction of new lantern slides.[69]

Prof. Starr's 40-Year Lecture Tour. Another prominent exhibitor of the oxyhydrogen microscope in the 1850s and beyond was Alfred Adolphus Starr (1820-1897). Starr was born in New York and initially tried his hand as a merchant, but gave that up in 1845 to become a lecturer. Apparently he started with a home-made oxyhydrogen microscope, but eventually purchased a high quality instrument. He was unusual in several ways. First, throughout his career, the oxyhydrogen microscope was the featured attraction of his lectures, rather than being an add-on to a magic lantern show or lecture. He did, however, include "illuminated views" with the magic lantern in at least some lectures.

He also was a ventriloquist, and used those talents to amuse adults and children alike. Starr's presentations were primarily designed to entertain his audiences; *The New York Times* described one of his presentations as "one of the most wonderful, instructive and laughter-provoking entertainments . . . ever witnessed." Starr was unusual among "scientific" lecturers in continuing his exhibitions through the Civil War years. In the early 1860s, most illustrated science lectures disappeared, as potential lecturers and male audience members went off to war. Even newspaper stories about popular scientific subjects largely vanished, replaced by battle reports and death notices. In 1865, a number of scientific gentlemen organized the New York Microscopical Society and named Starr as the first President.[70]

From 1845 until about 1884, Starr lectured mostly in small venues—churches, schools, Odd Fellows Halls, Y.M.C.A. meeting halls, etc. Judging from newspaper accounts, his exhibitions hardly changed at all over nearly 40 years. They included the standard array of highly magnified bee tongues, fly eyes, and insect wings, along with living aquatic insects in a tank. Generally the high point of each presentation was the feeding of a live Water Tiger (see back cover), often at precisely 8:30 PM. A newspaper account from 1880 dramatically described this feature of the program:

> The great act was reserved for the last; the water tiger was brought out to be fed. An innocent little creature was put into the water with the tiger, and the big fellow let him skip around

> and flourish for a while, for all the world like a "master" in Wall street, and then the tiger made a spring, and behold! the innocent little insect was swallowed; you could see him going down the tiger's throat and away down into his innards. Then the tiger brought out a couple of arms he had not used before, and patted himself over the jaws, as if he were saying to himself: "Well done, old boy."

At least by the 1870s, Starr advertised his lectures through the National Lecture Bureau located at Cooper Union in New York, but most of his lectures seem to have been in the Northeast, with occasional forays westward to cities such as Cincinnati, Detroit, and Minneapolis. Initially, he was invariably called Mr. A. A. Starr, but in about 1859, he started using the honorific, probably self-bestowed, of Prof. A. A. Starr.[71]

The newspaper record of Starr's itinerary, probably quite incomplete, starts in December 1851, when he exhibited his Hydro-Oxygen Microscope at the Broadway Tabernacle in New York. His whereabouts in 1852 are unknown, but in January 1853, he was again in New York, this time at Metropolitan Hall (lower saloon), where he announced that "the water tiger will be fed at half past eight o'clock, on living creatures." In May 1853, he appeared at Gilman's Saloon in Hartford, Connecticut (Fig. 35), where the ever-present Water Tiger was to be magnified to 20 feet long. He was at the First Congregational Methodist Church in Brooklyn in December 1856, St. James Hall in Buffalo in June 1858, Concert Hall in Burlington, Vermont in September 1858, and the Melodeon in Cleveland in September 1859. In Burlington, the feeding of the Water Tiger was incongruously followed by magic lantern slides of the Holy Land.[72]

During the Civil War, several of Starr's exhibitions were benefits for Soldiers' Aid Societies and Sanitary Commissions, including at the Young Men's Hall in Detroit in June 1862 and at Cooper Institute in New York in February 1864. He also entertained soldiers at Soldier's Depot in New York in June 1865. From the 1860s to the 1880s, Starr often lectured at Y.M.C.A. halls and churches, including Henry Ward Beecher's Plymouth Church Sunday School in Brooklyn on Christmas 1862, Bethel of Plymouth Church in Brooklyn in November 1869, Westminster Presbyterian Church in Brooklyn in February 1870, the First Congregational Church in Chicago in September 1870, The Brooklyn Y.M.C.A. in February 1874, Fourth Church in Hartford in January 1876, Ross Street Presbyterian Church in Brooklyn in November 1877, Minneapolis in August 1879, and the Rondout Y.M.C.A. Hall in Kingston, New York in January 1884.[73]

GILMAN'S SALOON!
MAIN STREET.
MOST
EXTRAORDINARY CURIOSITIES!
THE
AZTEC
CHILDREN!
OPEN FOR A FEW DAYS ONLY!
Commencing Monday, March 31st, 1851.

These celebrated Curiosities differ materially from any specimen of humanity heretofore seen — being most diminutive in stature, yet perfect in form.

But there is nothing dwarf-like in their actions or appearance. As specimens of humanity, they are perfectly *unique*. It is impossible for description to give an adequate idea of their great singularity. The following short extract from an article in the Boston "Times," in relation to them, will correct an erroneous impression of them as unpleasant objects.

"Their appearance is highly pleasing and attractive, but altogether unique. It is quite a mistake about their being monstrosities or anything of the Simia tribe, resembling humanity merely — a remark sometimes unjustly made by those who have never seen them. They are *bona fide* children, as interesting as they are wonderful."

MEASUREMENT AS GIVEN BY DR. WARREN TO THE BOSTON NAT. HIST. SOC. 1ST JANUARY MEETING.

"Dr. J. M. Warren read a paper containing some observations upon the two remarkable Indian Children from Central America, which have lately attracted the attention of scientific men and the public in this city. The Boy is 33¼ inches in height, and his weight is 20⅝ lbs The Girl 29½ inches, and weighs 17 lbs."

MEASUREMENT OF GIRL'S HEAD.
Head 13 inches in circumference.
Ant. Post. diameter, 4⅛ inches.
Lateral diameter, 3¾ inches.
Over the top of the head, from one auditory passage to the other, 8 inches.
Ear, 1¾ inches.
Facial angle, 65.

MEASUREMENT OF BOY'S HEAD.
Circum. over hair and scalp, 13 inches.
Ant. Post. diameter, 4¾ inches.
Bi Temporal, not quite 4 inches.
From one auditory passage, around the head, to the other, 7½ inches.
Ditto, around the occiput, 5½ inches.
Fronto occipital curve, 8 inches.
Ear, 2 inches.
Facial Angle, 60.

Dr. W. then remarked that in appearance they were agreeable and intelligent, apt to comprehend, particularlay if accompanied by proper gestures.
The paper read was lengthy and highly interesting.

Hours of Exhibition — Afternoon, from 2 till 5; Evening, 7 to 9.

Admittance 12½ Cents — without distinction of Age.

STEAM PRESS OF ELIHU GEER, 10 STATE STREET.

Fig. 35. Broadside advertising Gilman's Saloon in Hartford, Connecticut in March 1851. The Aztec Children were two children with microcephalic heads and cognitive disabilities from El Salvador. They were exhibited in "human zoos" during the 19th century.

http://connecticuthistoryillustrated.org/islandora/

The 1870s and Beyond. By the 1870s, the appeal of the oxyhydrogen microscope as an entertainment spectacle was beginning to fade in the United States. At a time when audiences were becoming better educated and more sophisticated, one Philadelphia newspaper suggested that spectacles like the oxyhydrogen microscope had little prospect of reaching less educated audiences:

> One of the most popular forms of microscopic exhibition is the display of living creatures by means of the oxy-hydrogen microscope. The ignorant and the scientific can both enjoy an exhibition of this sort. The various objects

> pass in review before them as the red and yellow moveable slides of magic lantern pictures when shown to admiring Sunday school children. The Sunday school children utter and exclamation of delight on the appearance of each new picture. Then they utter another exclamation indicative of their desire to see the next picture. So with microscopy. While a devotee of science may gaze for an hour on the feather of a moth, or on a peculiar style of crystal, the uncultured admirer of pretty combinations of color is pleased with constant change and clamors for more. It is a funny sight to see an enthusiast with his microscope trying to interest a bumpkin whose only idea of what he sees is that of a brilliantly-colored disk with certain things upon it of which he has no comprehension. After a little while the bumpkin's eyes grow weary and he falls asleep, leaving the microscopist in a state of ineffable disgust.[74]

Despite this pessimistic view, a few amateur microscopists continued to exhibit the oxyhydrogen microscope. In addition to Prof. Starr, who continued into the 1880s, one of the most prominent was Rev. E. C. Bolles (1836-1920). I did not do a comprehensive newspaper search for his whole career, but he appears to have lectured with the microscope around New England, mostly in the winter, in the 1870s. In January and February 1872, he appeared with the oxyhydrogen microscope in both Salem, Massachusetts and Portland, Maine. He appeared in Providence, Rhode Island in January 1874; in Lewiston, Maine in November 1875; in Fitchburg, Massachusetts in December 1875; and in Lowell, Massachusetts in January 1879. As late as December 1896, he lectured with the oxyhydrogen microscope on "Little Things in Nature" at the Brooklyn Institute in Brooklyn, New York.

Bolles's real passion was history, particular the history of London. While living in London in the early 1870s, he assembled a large collection of rare books, maps, and other materials on the history of the city. He frequently gave stereopticon lectures on London and other subjects, such as amateur photography. In 1900, he became the first Dickson Professor of English and American History at Tufts University, and in 1905, the first Chaplain of the university. Apparently he was quite popular as a lecturer, both with the oxyhydrogen microscope and the stereopticon. In 1876, a correspondent writing in *The Monthly Journal* of the Brotherhood of Locomotive Engineers described a free lecture on London given to that organization:

> Some weeks ago the Rev. E. C. Bolles, of Salem, informed some of our Brothers that he would give us a free lecture, either upon the wonders of the microscope or his travels in Europe, illustrated by the stereopticon . . . . [On December 19, 1875, he delivered a lecture on London]. There were nearly eighty views of places of note and fine works of art, which may be seen within the limits of the great city, put upon the screen by Mr. Bicknell, of Cambridge, who gratuitously assisted Mr. Bolles with his stereopticon; many of which were of places and buildings of great historical interest, and each as they appeared, was explained and commented upon by the speaker, in his ever pleasant and familiar way. . . .
>
> Mr. Bolles is one of our very popular public speakers, having engagements to lecture in many of the principal places throughout New England during the winter season, and is always a favorite with all who are so fortunate to hear him. He is a very scientific man, and many of his lectures are upon subjects of a scientific nature. I think he is one of the most interesting speakers it has ever been my privilege to hear.[7]

When he lectured in Lewiston, Maine in the same season, the local paper was equally effusive about his skill as a lecturer with the microscope:

> The lecturer was E. C. Bolles of Salem, who illustrated what he had to say about the microscope and its revelations, by means of a white screen stretched across the proscenium, and a powerful oxy-hydrogen microscope at the rear of the hall. The assertions of the lecturer in regard to the wonders and beauties of the microscopic world were therefore verified by a succession of vivid pictures upon the screen; and as the lecturer was as eloquent as his pictures were interesting, the result was a delightful evening for both eyes and ears.
>
> There is every reason why the lecture should be nearly perfect of its kind. Voice and style are so admirable that even prejudice would search long and hard before finding a flaw in his oratory. He brings to the platform elocutionary powers which would make a recitation of the Greek alphabet, or even of old election returns, brilliant and interesting. This is his first qualification as a lecturer. . . .
>
> He is the rare example of a dilettante whose opinions have weight with professionals. We must add, then, to his qualifications for the

> lecture platform a good subject, in which he is personally interested, and abundant ability to illustrate it.
>
> The most exacting public could not ask for more. The conditions for a good lecture were so completely fulfilled that, from the start, the audience found itself in perfect chord with the speaker, ready to laugh at his jokes, see picture after picture with the eagerness of children at a magic lantern exhibition, and render the homage of hearty applause to rhetoric that was really as brilliant as the calcium light in the back gallery.[76]

While a few amateur microscopists continued to give entertaining public exhibitions of the oxyhydrogen microscope, the overall trend after 1870 was in the direction of more serious scientific lectures, illustrated by the microscope, and often delivered by professional scientists. Before the Civil War, the United States had few professional scientists (those who made a living doing science), and none with advanced training in the United States. The first Ph.D. degree in science was awarded by Yale University in 1861. After the war, there was exponential growth in public education in general and higher education in particular, with dozens more Ph.D. granting universities being founded.

Increasingly, scientists delivered illustrated lectures at meetings of learned societies, and even full courses of lectures in public venues, where educational value superseded entertainment value. For example, in May 1870, Dr. John Gibbons Hunt, a leading microscopist and Professor at the University of Pennsylvania Medical School, lectured with the oxyhydrogen microscope at the College of Physicians in Philadelphia (Fig. 36). In October 1870, Hunt lectured with the gas microscope and stereopticon at the meeting of the Optical Section of the Academy of Natural Sciences in Philadelphia.

Cystopteris fragilis. Veins. Spores. Theca. Cells.
Prepared by J. G. HUNT, M. D. Philadelphia
Aspidium Thelypteris Double Staining
Prepared by J. G. HUNT, M. D. Philadelphia
Anatomy of the Cell a Cone view Spirogyra Dubia.
PREPARED by Dr. J. G. HUNT, Philada.
51

Fig. 36. Microscope slides prepared by John Gibbons Hunt. Courtesy of Brian Stevenson, University of Kentucky

In June 1870, Prof. James Aitken Meigs, an anatomist and anthropologist affiliated with the Academy of Natural Sciences and Jefferson Medical College, demonstrated the gas microscope at a meeting of the State Medical Society in Philadelphia. In November 1870, Prof. Henry Morton, a chemistry professor in Philadelphia, gave a lecture on the gas microscope at the Peabody Institute in Baltimore. Morton, who was a tireless advocate for the use of the magic lantern in science education, was a very popular public lecturer.

Other scientists and professors increasingly ventured into the public lecture realm. For example, Harvard Botanist George L. Goodale (Fig. 37) gave a series of four public lectures on botany at the Brooklyn Y.M.C.A. in January 1875, illustrated with the stereopticon and oxyhydrogen microscope. In 1878, Albert N. Blodgett, professor at the Boston Dental College, lectured on "Studies with the Microscope Under Calcium and Polarized Light" at the Boston Y.M.C.A.[77]

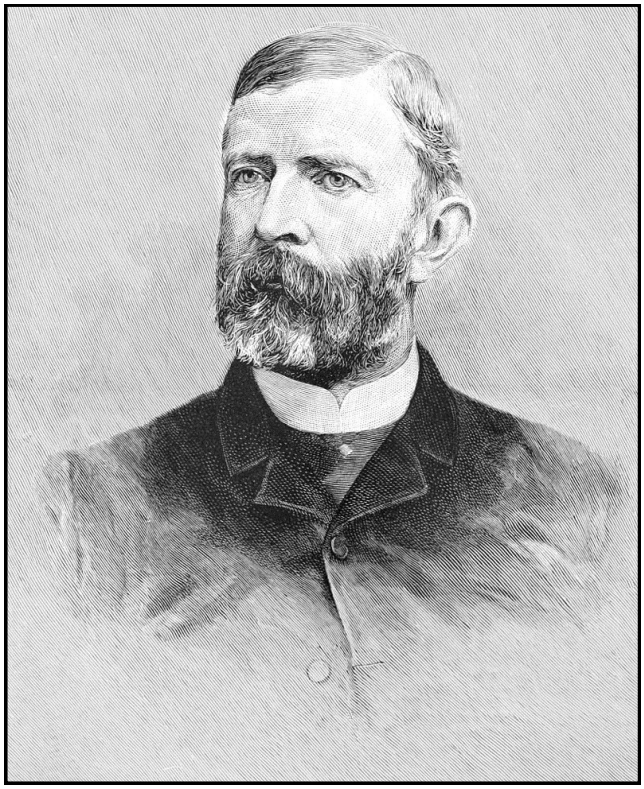


Fig. 37. Harvard Professor George L. Goodale, who lectured on botany with the stereopticon and oxyhydrogen microscope in the 1870s.

Popular Science Monthly, Volume 39 (December 31, 1890)

Meanwhile, the microscope itself was evolving. The simple oxyhydrogen microscopes of the early 19th century became increasingly complex "projection microscopes," more often associated with the university classroom than public entertainment. Other forms of illumination gradually replaced the more dangerous limelight, especially electric carbon-arc lamps and eventually incandescent electric lights. The culmination of technical evolution in the early 20th century was a projection microscope incorporated into an elaborate and expensive multi-function lantern capable of projecting almost any kind of image, from opaque objects and book pages to lantern slides, microscope slides, and living organisms (Fig. 38). This type of projector, a sort of Swiss Army Knife of magic lanterns, was far more suited to permanent installation in a college lecture hall or laboratory than as an instrument for itinerant lecturers.[78]

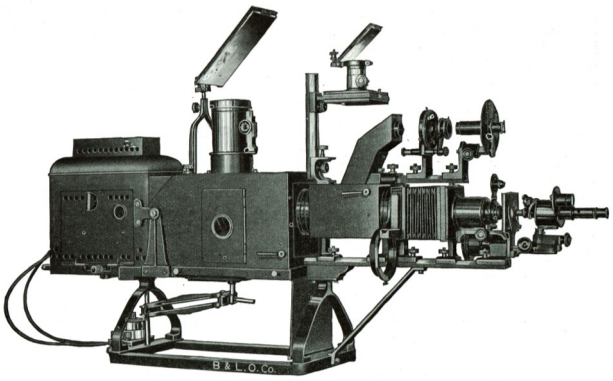


Fig. 38. The ultimate evolution of the oxyhydrogen microscope: 1913 Convertible Balopticon for all forms of projection. From: Gage and Gage 1914, p.304.

Notes and References

Nearly all of the early scientific papers and books cited here can be accessed on Google Books, Internet Archive, and other digital resources.

1. For an account of the solar microscope and its public display, see: Barbara Maria Stafford and Frances Terpak. 2001. *Devices of Wonder: From the World in a Box to Images on a Screen* (Getty Research Institute, Los Angeles), especially pp. 215-220. See also: Peter Heering. 2008. The enlightened microscope: re-enactment and analysis of projections with eighteenth-century solar microscopes. *British Journal for the History of Science* 41:345-367. For the cultural impact of microscopic images, including those of the solar microscope, see: Ursula Seibold-Bultmann. 2000. Monster soup: the microscope and Victorian fantasy. *Interdisciplinary Science Reviews* 25:211-219.

2. For detailed accounts of the Microcosm, see: Stuart Talbot. 2006. The perfectionist projectionist: Philip Carpenter, 24 Regent Street, London. *Bulletin of the Scientific Instrument Society*, no. 88:17-20; Phillip Roberts. 2017. Philip Carpenter and the convergence of science and entertainment in the early-nineteenth century instrument trade. *Science Museum Group Journal*, Spring 2017 (http://dx.doi.org/10.15180/170707).

3. Simon Henry Gage. 1908. The origin and development of the projection microscope. *Transactions of the American Microscopical Society* 28:5-60.

4. For biographical information on Hare, see: [Benjamin Silliman]. 1858. The late Dr. Robert Hare. *The American Journal of Science and Arts* 26:100-105. In this obituary, Silliman took the opportunity to vigorously defend Hare's priority for the invention of the oxyhydrogen blowpipe, and even suggested Hare deserved some credit for the invention of limelight. Other biographical sources include: "Sketch of Robert Hare," *Popular Science Monthly*, vol. 42 (March 1893); Edgar Fahs Smith. 1917. *The Life of Robert Hare, an American Chemist* (Lippincott Co., Philadelphia); Robert Hare, *Wikipedia*; Background note to the Robert Hare Papers, American Philosophical Society (https://search.amphilsoc.org/collections/view?docId=ead/Mss.B.H22-ead.xml;query=;brand=default#bioghist). Hare's description of the oxy-hydrogen blowpipe appeared in: Robert Hare. 1802. Memoir on the supply and application of the blowpipe. *The Philosophical Magazine* 14:238-245 and 298-306. Silliman's early experiments are described in: Benjamin Silliman. 1813. Experiments on the fusion of various refractory bodies, by the compound blow-pipe of Mr. Hare. *Memoirs of the Connecticut Academy of Arts and Sciences* 1:329-339.

5. For discussions of the Hare-Clarke controversy, see: D. R. Oldroyd. 1972. Edward Daniel Clarke, 1769-1822, and his rôle in the history of the blow-pipe. *Annals of Science* 29:213-235; Martin D. Saltzman. 2001. The Hare-Clarke controversy over the invention of the improved gas blowpipe. *Bulletin of the History of Chemistry* 26:106-111. Both authors agree that Hare deserves credit for the invention. See also: John Griffin. 1827. *A Practical Treatise on the Use of the Blowpipe* (R. Griffin & Co., Glasgow). John Joseph Griffin (1802-1877) was an artisan, author, and lecturer in the mold of Philip Carpenter and many others of the period. See: Brian Gee and William H. Brock. 1991. The case of John Joseph Griffin, from artisan-chemist and author-instructor to business-leader. *Ambix* 38:29-62.

Edward D. Clarke is not to be confused with Edward M. Clarke (1806-1859), Dublin and London instrument maker who sold and exhibited oxyhydrogen microscopes and made his own improvements to the oxy-hydrogen blowpipe. See: E. M. Clarke. 1837. Improvement in the mechanical arrangement of the hydro-oxygen blowpipe. *The Annals of Electricity, Magnetism, & Chemistry; and Guardian of Experimental Science* 1:303-305; Edward M. Clarke. 1842. *Directions for Using Philosophical Apparatus in Private Research and Public Exhibitions* (Edward M. Clarke, London). For Clarke's work with the oxyhydrogen microscope, see: Brian Gee. 1998a. The spectacle of science and engineering in the Metropolis. Part I: E. M. Clarke and the early West End exhibitions. *Bulletin of the Scientific Instrument Society*, no. 58:11-18; Jeremy Brooker. 2013. *The Temple of Minerva. Magic and the Magic Lantern at the Royal Polytechnic Institution, London 1837-1901* (The Magic Lantern Society, London).

Clarke became embroiled in a priority dispute with Philadelphia-born mechanic Joseph Saxton (1799-1873) over the invention of a magneto-electric machine. In the 1850s, Clarke sold his instrument business and made a disastrous financial investment in the Royal Panopticon of Science and Art, which effectively ended his career: Brian Gee. 1993. The early development of the magneto-electric machine. *Annals of Science* 50:101-133; Iwan Rhys Morus. 1998. *Frankenstein's Children: Electricity, Exhibition, and Experiment in Early-Nineteenth-Century London* (Princeton University Press, Princeton NJ), pp. 93-98; Brian Gee. 1998b. The spectacle of science and engineering in the Metropolis. Part II: E. M. Clarke and the Royal Panopticon of Sciences and Arts. *Bulletin of the Scientific Instrument Society*, no. 59:6-13; Bernard Lightman. 2012. Mid-Victorian science museums and exhibitions: 'The industrial amusement and instruction of the people'. *Endeavor* 37:82-93.

6. Robert Hare, M.D. 1828. *Compendium of the Course of Chemical Instruction in the Medical Department of the University of Pennsylvania* (J. G. Auner and Carey, Lea, and Carey, Philadelphia), pp. 19-22 of the Appendix. See also: Robert Hare, M. D. 1847. On certain improvements in the construction and supply of the hydro-oxygen blowpipe, by which Rhodium, Iridium, or the Osmiuret of Iridium, also Platinum in the large way have been fused. *The American Journal of Science and Arts*, second series 4:37-45.

7. Benjamin Silliman. 1818. On the compound blowpipe—extract from the *Journal de Physique* of Paris, for January 1818. *The American Journal of Science* 1:97-101; Benjamin Silliman. 1830. *Elements of Chemistry*. (Hezekiah Howe, New Haven, Connecticut), pp. 224-227; Silliman 1858 (see note 4). The cause of Hare's priority was taken up by Silliman's son, Benjamin Silliman, Jr. (1816-1885), also a Professor of Chemistry at Yale. See: Benjamin Silliman [Jr.]. 1874. American contributions to chemistry. *American Chemist*, August-September 1874, pp. 77-81. For other claims for Hare's priority, see: "Reinvention of Hare's compound blow-pipe," *Journal of the Franklin Institute*, vol. 11, no. 3 (March 1833), pp. 149-152; "Professor Daniell's oxy-hydrogen jet, previously invented and described by Prof. Hare," *Journal of the Franklin Institute*, vol. 11, no. 4 (April 1833), pp. 217-221; William Gorges, D. D. S. 1864. The blow-pipe. *Transactions of the Ondontographic Society of Pennsylvania* 1:44-56.

Professor Daniell was John Frederick Daniell (1790-1845), professor of chemistry at King's College, London. He developed a new type of oxyhydrogen jet. In 1833, he reported that using a stick of lime, he had "succeeded perfectly in exhibiting the beautiful experiment of Lieut. Drummond's light; and can produce a prismatic spectrum almost equal in brilliancy to the solar." See: J. F. Daniell. 1833. On a new oxy-hydrogen jet. *The London and Edinburgh Philosophical Magazine and Journal of Science* 2 (7):57-60. William Gorges, who delivered his 1863 lecture on the blowpipe to an audience of dentists interested in its use in the construction of dentures, was a colleague of Hare at the University of Pennsylvania. He strongly supported Hare's claim to having invented the oxyhydrogen blowpipe. In a demonstration of the blowpipe that followed Gorges's address, Henry Morton (1836-1902), also a professor at the University of Pennsylvania dental college, gave a more detailed account of Hare's complaint against Clarke and others. He also demonstrated the generation of limelight with the oxyhydrogen blowpipe and its use with a projecting microscope, the magic lantern, and ghost exhibitions.

8. The danger of Clarke's blowpipe is mentioned in *The London Journal and Arts and Sciences*, vol. 5 (1823), p. 107. Among many printed descriptions of Gurney's oxy-hydrogen blowpipe is one that accompanied presentation of the Gold Isis Medal by the Society of Arts, which appeared in: "Oxy-hydrogen Blow-pipe," *Transactions of the Society, Instituted at London, for the Encouragement of Arts, Manufactures, and Commerce* 41 (1823):70-77. See also: Goldsworthy Gurney, *Wikipedia*; Dale H. Porter. 1998. *The Life and Times of Sir Goldsworthy Gurney, Gentleman Scientist and Inventor, 1793-1875* (Lehigh University Press, Bethlehem, Pennsylvania); Pierre Lauginie. 2015. Drummond light, limelight: a device of its time. *Bulletin of the Scientific Instrument Society*, no. 127:22-28."Sir Goldsworthy Gurney—inventor of the limelight." (https://www.cornwalls.co.uk/history/people/goldsworthy_gurney.htm).

9. Quoted in Griffin 1827 (see note 5), p. 268.

10. Hare 1847 (see note 6), p. 37; Silliman 1813 (see note 4).

11. Hare 1847 (see note 6), p. 38. Peale appears to have experimented with Hare's oxyhydrogen blowpipe for up to ten years before 1817. See: Gorges 1864, Goode 1902 (see note 7).

12. Brewster quoted in an appendix to John F. McLennan. 1867. *Memoir of Thomas Drummond* (Edmonston and Douglas,, Edinburgh), p. 444.

13. The quotation about limelight from Gurney's 1823 lecture on the oxy-hydrogen blowpipe appeared in: Goldsworthy Gurney. 1823. *A Course of Lectures on Chemical Science, as Delivered at the Surrey Institution* (G. and W. R. Whittaker, London), pp. 294-295. On lighting up the theater, see Porter 1998 (see note 8), p. 67. On prismatic colors: In 1849, chemist Arthur Aiken (1773-1854) wrote to Michael Faraday about the early use of limelight: "I am perfectly certain that Mr. Gurney exhibited this light in the Society's great room [the Society of Arts] shewing among other things the brilliance & precision of the prismatic colors produced by means of it; but as no record exists of this I presume it was a mere exhibition unaccompanied by any written communication. In April 1823 an improvement to the apparatus for the safe use of the oxy-hydrogen blowpipe was favourably reported by the Committee on Chemistry & probably his exhibition of the lime-light took place at about the same time." Frank A. J. L. James, ed. 1999. *The Correspondence of Michael Faraday, vol. 4, January 1849-October 1855* (The Institution of Engineering and Technology, London), pp. 10-11.

14. "Mr. Lewthwaite's Lecture on the Blow-pipe," *The London Mechanics' Register*, vol. 3 (1826), pp. 130-133. John Lewthwaite was an engineer who gave a series of lectures on electricity at the London Mechanics' Institution in 1824. He was a regular lecturer at several other London institutions in the 1820s. See: Helen Hudson Flexner. 2014. *The London Mechanics' Institution: Social and Cultural Foundations 1823-1830*. Ph.D. dissertation, University College London, p. 435 (http://discovery.ucl.ac.uk/1417470/1/Flexner%202014%20UCL%20PhD%20London%20Mechanics%20Institution.pdf.)

15. On Hare, see Gage 1908 (see note 3), p. 19. On Gurney, see "Sir Goldsworthy Gurney" (see note 8). Many other websites attribute the discovery of the "limelight effect" to Gurney (e.g. https://alchetron.com/Limelight-3304202-W). See also Porter 1998 (see note 8), who says Gurney coined the term limelight and used it to light up a theater during a lecture at the Surrey Institution (pp. 67, 137).

16. For modern scholarship on the oxy-hydrogen blowpipe and the development of limelight, see: M. Lindsay Lambert. 1997. Origins and early history of limelight, pp. 46-51. In: Dennis Crompton, Richard Franklin, and Stephen Herbert, eds. *Servants of Light. The Book of the Magic Lantern* (The Magic Lantern Society, Ripon, North Yorkshire, England); Lauginie 2015 (see note 8). See also: McLennan 1867 (see note 12); Thomas Drummond. 1826. On the means of facilitating the observation of distant stations in geodiedical operations. *Philosophical Transactions of the Royal Society of London* 116:324-337. For Drummond's work with the Ordnance Survey, see: Rachel Hewitt. 2011. *Map of a Nation: a Biography of the Ordnance Survey* (Granta Books, London).

17. Kentwood D. Wells. 2017. Dionysius Lardner: popular science showman of the 1840s. *The Magic Lantern Gazette* 29 (1):3-18.

18. John George Goddard. 1884. *George Birkbeck, the Pioneer of Popular Education* (Bemrose & Sons, London); George Birkbeck, *Wikipedia*; Thomas Kelly. 1957. *George Birbeck, Pioneer of Adult Education* (Liverpool University Press); Flexner 2014 (see note 14).

19. John Thomas Cooper, *Wikipedia*; Lambert 1997 (see note 16); Lauginie 2015 (see note 16); "The Cary-Gould-Porter optical business" (http://microscopist.net/GouldC.html). In addition to playing a central role in the development of the oxy-hydrogen microscope, Cooper was an important figure in the development of photography in England. Inspired by recent experiments by Henry Fox Talbot, he developed a method to prepare paper for photo-

graphic drawings, and in 1839, he was awarded a silver medal by the Society of Arts for his work. At the time, Cooper was the resident chemist at the Polytechnic Institution. In a lecture in 1839, he used the light of the Polytechnic's oxy-hydrogen microscope to expose photographic plates while demonstrating the entire process of preparing daguerreotypes, the main photographic process competing with the paper prints favored by Talbot. Cooper also was the chemistry teacher for John Henry Pepper, future head of the Polytechnic. See: "Preparation of photogenic paper," *Transactions of the Society Instituted at London for the Encouragement of Arts, Manufactures, and Commerce*, vol. 52 (1839), pp. 193-196; Brooker 2013 (see note 5), pp. 46, 54, 84.

20. Charles Woodward. 1851. *A Familiar Introduction to the Study of Polarized Light; with a Description of, and Directions for Using, the Table and Hydro-Oxygen Polariscope and Microscope* (John Van Voorst, London).

21. "Dr. Birkbeck's lecture on telescopes and microscopes." *The London Mechanics' Register*, no. 61 (Saturday, November 26, 1825), p. 67. The previous January, Charles Frederick Partington showed a prismatic color spectrum using a magic lantern at the same institution. From the description of his lecture on optics, it is not clear whether he simply showed a slide with a diagram of the color spectrum or actually projected light through a prism. If the latter is the case, then it is hard to imagine how he could produce a pure white light without using limelight. "Mr. Partington introduced the phantasmagoria lantern . . . to show the manner in which light is refracted during passage through lenses of different forms. The lights in the lecture room being lowered, the various images were very distinctly thrown upon a screen, and the first represented the division of a ray of light into seven different colours on passing through a prism." "Mr. Partington's first lecture on optics." *The London Mechanics' Register*, no. 13 (Saturday, January 29, 1825), p. 199. Partington was a prolific popular lecturer and author, with books on everything from natural history to the steam engine and printing and lithography (https://www.goodreads.com/author/list/4500296.Charles_Frederick_Partington).

22. Woodward 1851 (see note 20), p. 41.

23. "Pritchard, Andrew" [from the Dictionary of National Biography) (https://en.wikisource.org/wiki/Pritchard_Andrew); C. R. Goring and Andrew Pritchard. 1837. *Micrographia: Containing Practical Essays on Reflecting, Solar, Oxy-Hydrogen Gas Microscopes; Micrometers; Eye-Pieces, &c. &c.* (Whittaker & Co., London), p. 170. Pritchard wrote the section of the book on the oxy-hydrogen microscope.

24. Goring and Pritchard 1837 (see note 23), p. 171.

25. Frederick Kurzeer. 2000. A history of the Surrey Institution. *Annals of Science* 57:109-141.

26. "Dr. Birkbeck's lecture" (see note 21), p. 69.

27. For the use of "transparency" and "transparent diagram" for lantern slides by Dionysius Lardner in the 1840s, see Wells 2017 (see note 17). Birkbeck's lectures with transparencies: "Dr. Birkbeck's second lecture on the general principles of mechanical science." *The London Mechanics' Register*, no. 45 (Saturday, August 13, 1825), pp. 259-266; "Dr. Birkbeck's fifth lecture on various modern mechanical inventions." *LMR*, no.106 (Saturday, September 23, 1826, pp. 347-350. This lecture account mentions that the theater was darkened for display of a transparency. Description of the frame for transparencies and its use: "Dr. Birkbeck's first lecture on the general principles of mechanical science." *LMR*, no. 44 (Saturday, August 6, 1825), pp. 242-248.

28. "Mr. Wallis's first lecture on astronomy." *LMR*, no. 34 (Saturday, June 4, 1825), pp. 85-89. This lecture included a moving transparency demonstration of a ship moving over the horizon, a common type of astronomical slide available from Carpenter and others: "The lecture room was darkened, and the central curtain being drawn up, exhibited to the audience a brilliant transparency of the earth, about four feet in diameter on which the vast continent of America was correctly delineated. At the top of the lucid ring which surrounded this globe, a mountain was depicted, and a small ship appeared upon another part of the earth's surface. This vessel was put in motion by means of the internal machinery, and its gradual motion, as it approached the mountain, and after passing it, sank below the horizon as it receded from it, enabled Mr. Wallis to explain, in a very satisfactory and perspicuous manner, the rotundity of the earth" (p. 86). This first lecture included several other moving transparencies, and the account mentions that each time transparencies were to be displayed, "Mr. Wallis withdrew for a minute or two, to prepare other transparencies," language similar to that in descriptions of subsequent lectures. This lecture concluded with a particularly spectacular moving transparency: "It represented on a large scale, the twelve signs of the zodiac, brilliantly illuminated, with the sun in the centre, to whose rays a rapid motion was communicated by mechanical means, which gave it the appearance of a globe of living fire. Within the zodiacal circle, the earth was seen revolving on its axis, and travelling gradually through its orbit, so as to exhibit at one view a perfect illustration of the various changes of the seasons." (p. 89).

The descriptions of Wallis's visual effects, particularly the transparency of the signs of the zodiac, not only resemble those produced by contemporary astronomical lantern slides, but also Adam Walker's Eidouranion developed in the 1780s and exhibited in London for more than 50 years. The exact nature of the latter device is a matter of some debate, although some scholars suspect a magic lantern was involved in the motion effects. The description also resembles a mechanical device for displaying astronomical transparencies called the Vertical Tellurian, illustrated in *The Magazine of Science, and School of Arts* a decade and a half after Wallis's 1825 lectures. For discussion of astronomy lectures, the Eidouranion, and the confusing use of the term "transparency," see: Mark Butterworth. 2007. Astronomical lantern slides. *The Magic Lantern Gazette* 19 (2):3-13; Brooker 2013 (see note 5), pp. 22-27; Hsiang-Fu Huang. 2015. *Ouranologia: an Annotated Edition of a Lenten Lecture on Astronomy with Critical Introduction* (Department of Science and Technology Studies, University College London); Hsiang-Fu Huang. 2016. When Urania meets Terpsichore: a theatrical turn for astronomy lectures in early nineteenth–century Britain. *History of Science* 54:45-70; Dierddre Loughridge. 2016. Celestial mechanics: Adam Walker's Eidouranion, Celestina, and the advancement of knowledge, pp. 47-76. In: James Q. Davies and Ellen Lockhart, eds. *Sound Knowledge. Music and Science in London, 1789-1851* (University of Chicago Press, Chicago); Jan Golinski. 2017. Sublime astronomy: the Eidouranion of Adam Walker and his sons. *Huntington Library Quarterly* 80:135-157; Roberts 2017 (see note 2). Additional lectures by Wallis on astronomy, some illustrated by engravings of his transparencies, can be found in: 1825 series, 2nd lecture, *LMR*, no. 35 (Saturday, June 11, 1825), pp.98-122; 3rd lecture, *LMR*, no.36 (Saturday, June 18 1825), pp. 118-122; 4th lecture, *LMR*, no. 37 (Saturday, June 25, 1825), pp. 133-137; 5th lecture, *LMR*, no. 38 (Saturday, July 2, 1825), pp. 150-156. 1826 series, 3rd lecture, *LMR*, no. 85 (Saturday, April 29, 1826), pp. 2-10; 4th lecture, *LMR*, no. 86 (Saturday, May 6, 1826), pp. 18-25; 5th lecture, *LMR*, no. 87 (Saturday, May 13, 1826), pp. 34-41; 6th lecture, *LMR*, no. 88 (Saturday, May 20, 1826), pp.50-58 and *LMR*, no. 89 (Saturday, May 27, 1826), pp. 66 -69.

29. "Dr. Birkbeck's lecture" (see note 21), p. 71. The lucernal microscope, invented by George Adams in the 1780s, could be equipped with an Argand Lamp (or a magic lantern with an internal Argand Lamp) as a source of illumination to allow several people to view microscopic images, although the images would not have been as bright as those projected by a solar microscope or an oxy-hydrogen microscope.

30. "The oxy-hydrogen microscope," *Magazine of Science, and School of Arts*, no. 92 (1841), pp. 314-315; Gage 1908 (see note 3), p. 19; M. Lindsay Lambert. 1991. Limelight in a magic lantern, 1825. *The New Magic Lantern Journal* 6 (2):6-7; Bob Nuttall. 2011. Using a prototype oxy-hydrogen microscope in 1825: Birkbeck, Cooper and Woodward at the London Mechanics' Institution. *Queckett Journal of Microscopy* 41:381-384.

31. Edward M. Clarke 1842 (see note 5), p. 2. The Islington Literary and Scientific Society was established in the Borough of Islington, London in 1833 and acquired its own building with a lecture hall in 1837. Under the guidance of President Charles Woodward, the lectures included a heavy dose of science (http://www.british-history.ac.uk/vch/middx/vol8/pp. 45-51). Since 1980, the building has housed the Almeida Theatre (https://theatre.london/london-theatres/almeida-theatre/). Henry Wilkinson of Pall Mall was head of Wilkinson Sword, the official sword and gun maker to the British government. He had a strong interest in science and was friends with Michael Faraday (http://antiqueswordsforsale.com/history-of-the-wilkinson-sword-company/).

32. Daniel Cooper. 1841. A brief sketch of the rise and progress of microscopic science, and the principal means enumerated which have tended to its general advancement. *The Microscopic Journal, and Structural Record for 1841*, pp. 1-4. Daniel Cooper (1817-1842), second son of John Thomas Cooper, was trained as a physician, but also was an enthusiastic naturalist with ties to the zoological and botanical communities in London, where he sometimes lectured on botany. With George Busk (1807-1886), he founded the short-lived *Microscopic Journal*. His article designed to highlight his father's role in developing the oxyhydrogen microscope was the first paper published in the journal. In 1842, he joined the army as an assistant surgeon with the 17th Lancers at Leeds, but he died a few months later at age 25. See: Cooper, Daniel (*Dictionary of National Biography*, via Wikisource.org).

33. "Microscopic view of a drop of water," *The Tourist, or Sketchbook of the Times*, vol. 1 (1833), pp. 175-176, quoted in: "The Cary-Gould-Porter optical business" (see note 19), which also gives the most biographical detail on Gould. See also: Brooker (2013) (see note 5), pp. 26, 30, 32, 46, 47.

34. *The Spectator*, for the week ending Saturday, December 21, 1833. The partnership between Holland and Joyce was dissolved on September 15, 1834, but Holland continued to exhibit his microscope independently. See: *The London Gazette*, for the year 1834. Richard Altick mentioned the competition between Cary and Cooper and Holland and Joyce, but only referred to the latter as the "the New Bond Street exhibitors." See: Richard D. Altick. 1978. *The Shows of London* (Harvard University Press, Cambridge MA), pp. 369-371.

35. *The Spectator*, for the week ending Saturday, December 21, 1833. This account refers to a "white disc, eighteen feet in diameter" upon which the image from the microscope was projected. In fact, exhibitors of this era often used a round disc of Irish linen as a screen instead of a square screen; this could be easily rolled into position for the exhibition. See E. M. Clarke 1842 (see note 5), pp. 71-72. The elephant Chuny (Chunie, Chunee) was an Indian elephant that was an attraction in London from 1809 until 1826. He started out as a stage elephant and later was exhibited in a menagerie on the Strand, where he was the star attraction. In his later years, he became increasingly aggressive toward humans and was brutally put to death with muskets and a sword in 1826. His skeleton ended up at the museum of the Royal College of Surgeons until 1941, when it was destroyed by a direct hit from a German bomb. Weighing 5 tons and standing 11 feet tall, Chuny would have been the largest living animal seen in London at the time and thus a suitable reference point for the highly magnified flea. See: Altig 1978 (see note 34), pp. 310-316; Chunee, *Wikipedia*.

36. On Maugham and the oxyhydrogen microscope: Iwan Rhys Morus. 2007. "More the aspect of magic than anything natural": the philosophy of demonstration, pp. 336-370. In: Aileen Fyfe and Bernard Lightman, eds. *Science in the Marketplace. Nineteenth-Century Sites and Experiences* (University of Chicago Press, Chicago IL); Morus 1998 (see note 5), pp. 79-82. Hare's complaint: *Proceedings of the American Philosophical Society*, vol. 1, No. 5 (Nov. - Dec. 1838), pp. 60-62.

37. On Maugham's oxyhydrogen blowpipe: 'Oxy-hydrogen blowpipe," *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce for the Session 1834-1835*, vol. 50 (1836), pp. 41-48. On Goring's oxyhydrogen engiscope, built by Tulley, see: Goring and Pritchard 1837 (see note 23); C. R. Goring, M.D. and Andrew Pritchard. 1833. *Microscopic Illustrations of a few New, Popular, and Diverting Living Objects*. . . . (Whittaker, Treacher, and Arnot, London).

38. On Goddard and the oxy-hydrogen microscope: Brooker 2013 (see note 5), pp. 40, 48, 54. Goddard on polarized light: "Polarizing light," *Transactions of the Society Instituted at London for the Encouragement of Manufactures, and Commerce*, vol. 52 (1839), pp. 40-153; J. F. Goddard. 1839. On the use of the oxy-hydrogen microscope in exhibiting the phenomena of polarization. *Report of the Ninth Meeting of the British Association for the Advancement of Science* (John Murray, London), pp. 8-9; J. F. Goddard. 1839. On the polarization of light by living animals. *The London and Edinburgh Philosophical Magazine and Journal of Science*, vol. XV, pp. 152-153. On Goddard and photography: J. F. Goddard. 1841. Application of the daguerreotype to the taking of likenesses from the life. *Chemist, or Reporter of Chemical Discoveries and Improvements* 2:142-143; John Frederick Goddard 1797-1866 (http://www.southamptonvictorianphotographers.org/goddard_john_frederick).

39. Brooker 2013 (see note 5), pp. 49-52.

40. Clarke 1842 (see note 5).

41. Gee 1998a (see note 5), p.17.

42. Shea's lecture: Story from a London paper, reprinted in *The National Gazette* (Philadelphia), January 15, 1834, p.1. Dr. Goadby's lectures: London *Observer*, March 27, 1836, p. 3; April 23, 1848, p. 6. Goadby's lectures in America: *Brooklyn Evening Star*, May 9, 1851, p. 2; May 22, 23, 1851, p. 3; *Albany Evening Journal*, November 20, 1851, p. 3; *Buffalo Courier*, November 6, 1852, p. 2; *Buffalo Morning Express*, December 1, 1852, p. 2.

43. Oxyhydrogen microscope in Manchester: *Manchester Guardian*, June 7,, 1834, p. 1; July 12, 1834, p. 2; May 20, 1837, p. 3; April 15,, 1840, p. 1; April 18, 1840, p. 2; July 8, 1843, p. 4; December 23, 1843, p. 1. See also: William Sturgeon, *Wikipedia*. Sturgeon was the inventor of the first electromagnet capable of lifting more than its own weight.

44. Ian Inkster. 1975. Science and the Mechanics' Institutes, 1820-1850: the case of Sheffield. *Annals of Science* 32:451-474 (see pp. 461-462 for Morton and Chadburn). In the late 1830s, Morton was giving scientific lectures all over Yorkshire. Chadburn's firm produced a wide range of scientific instruments, some of which were

displayed at London's Great Exhibition in 1851. Nottingham exhibition: Susan Barton. 1993. The Mechanics' Institutes: pioneers of leisure and excursion travel. *Transactions of the Leicestershire Archaeological and Historical Society* 67:47-58. Salford: *Manchester Guardian*, July 8, 1843, p. 4; I. R. Cowan. 1968. Mechanics' Institutes and science and art classes in Salford in the nineteenth century. *The Vocational Aspect of Education* 20:201-210. The City of Salford is now a borough of Greater Manchester. The Mechanics' Institute was founded in 1838 and lasted until 1843. Hearder: For a detailed newspaper survey of exhibitions in provincial cities, and for Hearder's lecturing career, see: John Plunkett and Jill A. Sullivan. 2012. Fetes, bazaars and conversaziones: science, entertainment and local civic elites, pp. 41-60. In: Joe Kember, John Plunkett, and Jill A. Sullivan, eds. *Popular Exhibitions, Science and Showmanship, 1840-1910* (Pickering and Chatto, London). See also: Jonathan Nash Hearder, *Wikipedia*.

45. Two papers that describe Lover's lecturing career, and the Irish lecturing scene in general are: Enda Leaney. 2005. Missionaries of science: provincial lectures in nineteenth-century Ireland. *Irish Historical Studies* 34:266-288; Enda Leaney. 2008. "Evanescent Impressions": public lectures and the popularization of science in Ireland, 1770-1860. *Éire-Ireland* 43:157-182. See also: "Death of Dr. Lover," *The Irish Builder*, September 1, 1864; Kevin Rockett and Emer Rockett. 2011. *Magic Lantern, Panorama and Moving Picture Shows in Ireland, 1786-1909* (Four Courts Press, Dublin), pp. 58-59; William Lover. 1842. *Facts in Chemistry* (Charles Hedgelong, Dublin), p. 62; Thomas Grubb, *Wikipedia*; Grubb, Thomas (http://www.askaboutireland.ie/reading-room/life-society/science-technology/irish-scientists/thomas-grubb-(1800-1878)/. Announcements of Lover's lectures: *The Waterford News*, July 18, 1851, p. 3; July 28, 1854, p. 3.

46. Tom Lawrence. 1998. Giulio Regondi and the concertina in Ireland. *Concertina World*: *International Concertina Association Newsletter* 411 (July 1998):21-25. http://www.ucd.ie/pages/99/articles/lawrence.pdf [preview article with slightly different title]. Insect as Leviathan: quoted by Lawrence from: *The Wexford Freeman*, Wednesday 28 January 1835.

47. W. T. Stevenson. 1834. *A Companion to the Oxy-Hydrogen Microscope, Being a Description of Some of the Living Animals as Shewn by that Instrument now Exhibiting at Calcutta* (Samuel Smith & Co., Calcutta). *The Calcutta Monthly Journal* for September 1836 (p. 81) lists W. Stevenson as Assistant Surgeon with the Bengal Native Infantry. *The Asiatic Journal and Monthly Register for British India, China, and Australasia* for 1838 (p. 203) announced that Assistant Surgeon William Stevenson was promoted to Surgeon. He retired from service with the East India Company in 1842.

48. Elizabeth Hartrick. 2017. *The Magic Lantern in Colonial Australia and New Zealand* (Australian Scholarly Publishing, Melbourne), pp. 16, 28, 46. Newland in Sydney: *Sydney Morning Herald*, May 2, 1848, p. 1; May 11, 1848, p. 1; June 1, 1848, p. 1; June 20, 1848, p. 1. English-born John Proctor Hydes (1825-1882) was a popular singer, songwriter, actor, musician, and theater manager in Australia and, for a time, New Zealand. Popularly known as Congo Minstrel, he led a troupe of blackface minstrels into the 1880s, but also appeared in various dramatic, comedy, burlesque, pantomime, and variety shows. His first appearance in Australia was at the Royal Victoria Theatre in 1848 (https://ozvta.com/practitioners-h/). Oxyhydrogen microscope at Royal Polytechnic in Sydney: *Sydney Morning Herald*, February 21, 1854, p. 2; June 27, 1854, p. 5.

49. New York *American*, November 21, 1834, p. 3.

50. Dr. Weldon's identity is unknown. For Weldon's American Museum exhibitions: Story from the *New York Commercial Advertiser*, reprinted in *Eastern Argus* (Portland, Maine), March 13, 1835, p. 1; "Hydro-Oxygen Microscope," *The Family Magazine*, vol. 2 (1834-1835), pp. 287, 379. John Scudder's American Museum was in its Broadway location from the 1820s until 1841, when it was purchased by P. T. Barnum and became Barnum's American Museum.

51. For Weldon's 1836-1837 exhibitions: *Alexandria Gazette*, April 2, 1836, p. 3; *New York Evening Post*, April 23, 1836, p. 3; "History and Proceedings of the Mechanics' Institute of the City of New York," *The American Journal of Science and Arts*, vol. 30 (1836), p. 417; Louisville *Courier-Journal*, January 2, 1837, p. 2; January 31, 1837, p. 2 (ads appeared in many issues between January 2 and 31). Weldon's Hydro-Oxygen Microscope was offered for sale "at a small price" in New York in November 1844 (*New York Evening Post*, November 27, 1844, p. 3). The Louisville Museum and Gallery of Fine Arts was founded by Pennsylvania born artist James Reid Lambdin (1807-1889), who painted portraits of fifteen U. S. Presidents and other public figures such as Benjamin Franklin. After beginning his artistic career in Philadelphia, he returned to his home town of Pittsburgh, where he founded the Pittsburgh Museum of Natural History and Gallery of Fine Arts in 1828. This museum was modelled after Charles Willson Peale's Museum in Philadelphia and Rubens Peale's Museum in New York. In 1832, Lambdin moved his museum to Louisville. In addition to hosting exhibitions such as Weldon's hydro-oxygen microscope, the museum held a large collection of natural history specimens; Indian artifacts, weapons, and clothing; curiosities from the South Seas; and "a splendid specimen of the Rhinoceros."

There also was a Cosmorama showing different cities of Europe and America, a glass-working exhibition, and something called "the Spirits of Fire or Meeting of Witches, in which they will multiply from one to two hundred." The first exhibition of fine art at the museum in 1834 included Lambdin's portrait of George Catlin, painter of American Indians, who visited Louisville in 1833. In 1836, the Museum was visited by Mr. T. V. Skelline, an itinerant ventriloquist, who exhibited "all his feats in Ventriloquism and Natural Magic." For Lambdin's early career, see: http://www.librarycompany.org/artifacts/painters_lambdin.htm. For exhibits and Skelline's visit, see: Louisville *Courier-Journal*, May 25, 1836, p. 3; June 6, 1837, p. 3. For Lambdin and Catlin, see: Christian F. Feest. 2003. James Reid Lambdin, George Catlin, and the "Costume of a Sioux Warrior." *European Review of Native American Studies* 17 (2):19-26. Like many museums of that era, Lambdin's venture was a financial failure, and he sold his interest in the museum and its collections in 1837 and moved back to Philadelphia. Feest's article traces the subsequent movements of the museum's collections.

52. *Albany Argus*, April 21, 1835, p. 3. Handbill: https://www.antiquemapsandglobes.com/Book/Antique/Geography/Grand-Hydro-Oxygen-Microscope?B=13999 (accessed November 15, 2017).

53. *Lowell Patriot*, August 21, 1835, p. 3.

54. *Baltimore Gazette and Daily Advertiser*, October 8, 1835, p. 2.

55. *Connecticut Herald*, June 28, 1836, p. 3.

56. *Columbian Register*, July 2, 1836, p. 3.

56a. *New York Evening Post*, December 17, 1836, p. 3; *The Long Island Star*, April 6, 1837, p. 3; Philadelphia *Public Ledger*, May 17, 1837, p. 3; *New York Evening Post*, May 27, 1837, p. 2 and July 5, 1837, p. 3; *Mississippi Free Trader*, June 22, 1838, p. 2. For the Haningtons and their Dioramic Institute, see: Erkki Huhtamo. 2013. *Illusions in Motion: Media Archaeology of the Moving Pan-*

orama and Related Spectacles (MIT Press, Cambridge MA), p. 155; Genoa Shepley. 2015. By which melancholy occurrence: the disaster prints of Nathaniel Currier, 1835-1840. *Panorama*, Fall 2015 (http://journalpanorama.org/by-which-melancholy-occurrence-the-disaster-prints-of-nathaniel-currier-1835-1840/. Afong Moy was the first female Chinese immigrant to the United States. She was exhibited as a Chinese curiosity and performed in New York and around the country from 1834 to at least 1850. See: John Haddad. 2011. The Chinese Lady and China for the ladies: race, gender, and public exhibition in Jacksonian America. *Chinese America: History & Perspectives* 2011:5-19. Robert Hanham Collyer (1814-c.1891) was an itinerant mesmerist, phrenologist, lecturer, and showman (https://www.eapoe.org/people/collyerh.htm).

57. Wells 2017 (see note 17). Lardner's lecture on the gas microscope: *Philadelphia Public Ledger*, June 28, 1844, p. 1. On Grant's exhibition of the Cameroscope with Dioramic Paintings (a magic lantern), the Hydro-Oxygen Microscope, a demonstration of the Drummond Light, and the Gyptoscope (a device for projecting busts and statuary, claimed to be perfected by Grant and Lardner), see: *Alexandria Gazette*, November 27, 1843, p. 3. Grant with oxyhydrogen microscope and Virginia Minstrels: Washington *Madisonian*, November 13, 1843, p. 3. The Virginia Minstrels were among the first blackface minstrels to appear in a group. They first performed in New York in January 1843. Their makeup and costumes exploited crude racial stereotypes. See: Virginia Minstrels, *Wikipedia*.

58. *Philadelphia Public Ledger*, November 18, 1844, p. 2; *Baltimore Sun*, December 6, 1844, p. 2; *Baltimore Daily Commercial*, December 9, 1844, p. 3. Microscope at Barnum's Museum: *New York Evening Post*, October 8, 1845, p. 3; February 16, 1846, p. 3. Kennedy and Lillie: *Pittsburgh Daily Post*, August 31, 1847, p. 3; November 13, 1847, p. 2 (in Cincinnati); January 17, 1848, p. 3 (in New Orleans); *Vicksburg Weekly Sentinel*, January 18. 1848, p. 3 (Jackson and Vicksburg); New Orleans *Times Picayune*, December 30, 1847, p. 2; *Vicksburg Daily Whig*, February 5, 1848, p. 4. Lillie's engine: "The Electro-Magnetic Engine," *The Farmer and Mechanic*, April 29, 1847, p. 212.

59. Naphegyi as con man and swindler: *The Star State Patriot* (Marshall TX), May 15, 1852, p. 2; "Dr. Sonnenberg alias Naphegyi," *Weekly Journal* (Galveston TX), May 21, 1852, p. 2; *The Daily Picayune* (New Orleans), June 18, 1852, p. 1; *New York Times*, July 27,, 1852, p. 4; *The Daily Picayune*, May 12, 1853, p. 2; "An alleged swindler in difficulty," *New York Times*, February 28, 1867, p. 8; "Santa Anna and his New York patron," New York Times, June 23, 1867, p. 4; "The alleged Naphegyi fifty thousand dollars forgery," *New York Herald*, April 30, 1868, p. 7; "The case of Col. Naphegyi—discharge of the accused," *New York Times*, May 5, 1868; *Daily National Intelligencer* (Washington), May 6, 1868, p.2; "Gabor de Naphegyi," *San Antonio Express*, May 17, 1868, p. 1; "Arrest for swindling," Chicago *Sunday Times*, January 11, 1874, p. 3; "The Naphegyi case," *New York Tribune*, January 23, 1874, p. 2; "Dr. G. Naphegyi vindicated," *New York Tribune*, January 26, 1874; "The Naphegyi affair (business troubles in Venezuela that almost led to an international incident)," *New York Herald*, February 24, 1880, p. 9.

60. *Proceedings of the Senate of the University of Toronto*, May 21, 1851, p. 275.

61. "Santa Anna and his New York Patron," *New York Times*, June 23, 1867, p.4.

62. *Proceedings* (see note 60).

63. "Gabor de Naphegyi," *San Antonio Express*, May 17, 1868, p. 1. Dr. Simon Pollak was a fellow Bohemian immigrant who was a prominent physician in St. Louis (http://jmaw.org/dr-pollak-jewish-st-louis). Dr. Charles Alexander Pope (1818-1870) was a leading St. Louis surgeon: "Dr. Charles Alexander Pope," *St. Louis Courier of Medicine*, vol. 30 (January-June 1904), p. 251. Dr. H. A. Prout was a St. Louis physician and paleontologist who described many animal and plant fossils. In the 1840s, he did pioneering work in the White River Badlands fossil beds, a major site for western paleontology: *Bulletin no. 4 of the South Dakota School of Mines, Department of Geology*, April 1909, p. 10.

64. *Daily National Intelligencer*, January 9, 1850, p. 3.

65. Washington lecture: *Daily National Intelligencer*, January 15, 1850, p. 1. Carusi's Saloon was a music and dance hall and a major venue for meetings and lectures in early 19th century Washington. It was the site of several Presidential Inaugural Balls, including Andrew Jackson, Martin Van Buren, William Henry Harrison, and James K. Polk. From 1841 to 1843, the Washington city post office was located on the lower level. See: Madison Davis. 1903. A history of the city post-office. *Records of the Columbia Historical Society* 6:143-213. Baltimore lectures: *Baltimore Sun*, January 1, 1851, p. 2; January 29, 1851, p. 3.

66. Sally Pierce. 2003. Whipple's Dissolving Views. *The Daguerreian Annual* 2002-2003:277-295. Pierce incorrectly dates the beginning of the shows at the Melodeon to March 11,, 1850, but a newspaper ad for February 18 announces the show "this evening" at the Melodeon: "Optical Wonders at the Melodeon," *Boston Courier*, February 18, 1850, p. 3. See also: *Massachusetts Spy* (Worcester), May 8, 1850, p. 2. For Whipple's photographic career, see: Sally Pierce. 1987. *Whipple and Black: Commercial Photographers in Boston* (Boston Athenaeum, Boston). The device to reduce the heat reaching the live animals consisted of a water-filled tank inserted between the limelight and the tank holding the animal; it had been around for some time. See: E. M. Clarke 1842 (see note 5), p. 69.

67. Peals of laughter: *Boston Evening Transcript*, May 7, 1850, p. 2. Lenses: "Whipple's Optical Exhibition," *Boston Evening Transcript*, April 5, 1850, p. 2.

68. Pierce 2003 (see note 66); *Barre* (MA) *Patriot*, May 24, 1850, p. 2; *Hartford Daily Courant*, June 18, 1850, p. 2; *New Bedford Mercury*, August 23, 1850, p. 3 and August 30, 1850, p. 4; *Boston Daily Atlas*, September 6, 1850, p. 2 and September 10, 1850, p. 2 (story from Newport News); *Boston Evening Transcript*, September 10, 1850, p. 2 and October 4, 1850, p. 2; Washington *Daily National Intelligencer*, December 23, 1850, p. 3; Washington *Daily Globe*, December 28, 1850, p. 4; Washington *National Era*, January 2, 1851, p. 3; *Baltimore Sun*, February 4, 1851, p. 2; *Salem Register*, April 28, 1851, p. 3.

69. Pierce 2003 (see note 66); *The Portsmouth Journal*, May 17, 1851, p. 2; *Portland Daily Advertiser*, June 2, 1851, p. 2 and June 7, 1851, p. 2; *New London Democrat*, January 24, 1852, p. 2; *Pittsfield Sun*, March 11, 1852, p. 2; *Buffalo Morning Express*, January 17 and 18, 1853, p. 3; *The Summit County Beacon* (Akron OH), March 16, 1853; *The Portage Sentinel* (Ravenna OH), March 23, 1853; *The Pittsburgh Gazette*, April 16, 1853, p. 2; *The Buffalo Daily Republic*, December 30, 1854, p. 2 and January 2, 1855, p. 3; *The Hillsdale Standard*, August 16, 1859, p. 2. For a detailed discussion of the use of the word "chemical" in relation to optical attractions and shows, see: Suzanne Wray. 2007. R. Winter's Unrivalled Exhibition of Chemical Dioramas, Crystalline Views, Cromotropes, &c.: The travelling exhibitions of Robert Winter. *The Magic Lantern Gazette* 19 (4):8-19. Ellen G. White (1827-1915) was one of the most influential religious leaders of the 19th century and a founder of the Seventh Day Adventist Church. See: www.whiteestate.org/about/egwbio.asp.

70. "Alfred Adolphus Starr" (http://famousamericans.net/alfredadolphusstarr/); *New York Times*, June 3, 1865, p. 2; Society President: *New York Times*, July 7, 1865.

71. Feeding the water tiger: "Professor Starr's Menagerie," *Cincinnati Enquirer* (from *New York Times*), June 17, 1880, p. 11. Ad for Starr through National Lecture Bureau: *American Journal of Microscopy and Popular Science*, 1877.

72. *New York Times*, December 23, 1851, p. 2; *New York Daily Herald*, January 9, 1853, p. 3; *Hartford Courant*, May 12, 1853, p. 3; *Brooklyn Evening Star*, December 4, 1856, p. 2; *Buffalo Morning Express*, June 12, 1858, p. 3; *Burlington Free Press*, September 13, 1858, p. 2; *Cleveland Daily Leader*, September 14, 1859, p. 3. Gilman's Saloon was a meeting hall in Hartford that hosted concerts, dances, lectures, and Barnum-like attractions like the Aztec Children. Oddly, it also was the first home of the First Presbyterian Church, which had its initial meeting there in July 1851, four months after the Aztec Children were displayed (https://www.firstpreshartford.org/history.php).

73. *Detroit Free Press*, June 15 & 17, 1862, p. 1; *Brooklyn Daily Eagle*, December 26, 1862, p. 2; *Brooklyn Daily Eagle*, February 4, 1863, p. 1; *New York Times*, February 28, 1864, p. 8; *New York Times*, June 3, 1865, p. 2; *Brooklyn Daily Eagle*, November 23, 1869, p. 3; *Brooklyn Daily Eagle*, February 26, 1870, p. 3; *Chicago Tribune*, September 29, 1870, p. 4; *Brooklyn Daily Eagle*, February 18 & 20, 1874, p. 1, 2; *Hartford Courant*, January 1 & 6, 1876, p. 1, 2; *Portland Daily Press*, September 11, 1876, p. 1; *Brooklyn Daily Eagle*, November 14, 1877, p. 4; Minneapolis *Star Tribune*, August 14, 1879, p. 4; *Kingston Daily Freeman*, January 29, 1884.

74. "Microscopy Run Mad," *The Times* (Philadelphia), October 31, 1879, p.2.

75. Edwin Courtlandt Bolles was born in Hartford, Connecticut. He graduated from Trinity College in Hartford and was ordained as a Universalist minister in 1855, at age 19. He served in churches in New England, New York, and Louisiana, leaving the South at the beginning of the Civil War. In the 1870s, he lived for a time in Europe and then embarked on a lecturing career while pastoring several churches. He was an enthusiastic amateur naturalist. While serving a church in Portland, Maine, he was the secretary of the Portland Society of Natural History (http://maineaudubon.org/about/history-achievements/first-150-years/). He joined the Peabody Academy of Science in Salem, Massachusetts while serving in there as pastor of a church (https://dl.tufts.edu/catalog/tei/tufts:UA069.005.DO.0001/chapter/B00025). He began lecturing at the Divinity School at Tufts in 1889, and in 1900, was named Professor of English and American History. Bolles's lectures with the oxyhydrogen microscope: *Salem Register*, January 29, 1872, p. 2; *Portland Daily Press*, February 14, 1872; *Providence Evening Press*, January 12, 1874, p. 2; *Lewiston Evening Journal*, December 5, 1875; *The Fitchburg Sentinel*, December 6, 1875, p. 3; *Lowell Daily Citizen and News*, October 1, 1878; *Brooklyn Daily Eagle*, December 15, 1896, p. 7. London lecture: *The Monthly Journal* (Brotherhood of Locomotive Engineers), February 1876, pp. 71-72.

76. *Lewiston Evening Journal* (see note 75).

77. Brian Stevenson, "John Gibbons Hunt, 1826-1893" (http://microscopist.net/HuntJG.html). George Lincoln Goodale, *Wikipedia*. Philadelphia *Evening Telegraph*, May 14,, 1870, p. 1; *Philadelphia Inquirer*, May 16, 1870, p. 8; June 6, 1870, p. 2; October 27, 1870, p. 2; *Baltimore Sun*, November 25, 1870, p. 4; *Brooklyn Daily Eagle*, January 20, 1875, p. 1; *Boston Journal*, April 26, 1878, p. 4. On Morton and the magic lantern, see: Jeremy Brooker. 2017. A lecture on Locust Street. Morton, Tyndall, Pepper, and the construction of scientific reputation, pp. 111-138. In: Carin Berkowitz and Bernard Lightman, eds. *Science Museums in Transition. Cultures of Display in Nineteenth-Century Britain and America* (University of Pittsburg Press, Pittsburgh PA).

78. Gage 1908 (see note 3). Simon Henry Gage and Henry Phelps Gage. 1914. *Optic Projection* (Comstock Publishing Company, Ithaca NY).

The Brownies viewing highly magnified projections of insects. From: Palmer Cox. 1918. *Another Brownie Book* (The Century Company, New York).

Wells collection.

Buhoup's Great Floating Hindoo Pagoda

Suzanne Wray
252 W. 91st St. #54
New York, NY 10024-1159
gribble@earthlink.net

In the 1850s J. W. Buhoup traveled with an exhibition of "Chemical Dioramas and Chinese Pyric Fires," advertised as "the best thing ever introduced into the United States." Often finding it difficult to procure a hall large enough to accommodate his audience, Buhoup had the moveable Pagoda constructed in Pittsburgh. Designed to travel on a showboat, the Hindoo Pagoda was said to seat 2400 people. The Floating Hindoo Pagoda traveled the Ohio River until it was destroyed by fire in Trinity, Louisiana.

Johnathan W. Buhoup was born in 1825 in Allegheny City (now Pittsburgh), Pennsylvania. He became famous after the Mexican-American War, having written an account of his campaign in Chihuahua with an Arkansas cavalry regiment, which marched overland to Mexico. He fought in several battles, was taken prisoner, and escaped with the help of a Catholic priest, then rejoined his regiment, serving until the end of the war. [1]

In the 1850 Census, Buhoup is listed as a musician. As one of the Sable Brothers (Fig. 1), a black-face minstrel troupe, he had toured the Northeast in the 1840s and 1850s, performing in Pittsburgh, Washington, New York City, Boston, and other cities in Massachusetts, Rhode Island, Connecticut, and New York.[2]

The first record I have found of him as a chemical diorama showman is dated August 12, 1854. The *Wheeling* [Virginia—later West Virginia] *Daily Intelligencer* advertised that Buhoup's Chemical Dioramas and Chinese Pyric Fires, "Scientific and Beautiful," would be exhibited for three days only at the Melodeon Hall, beginning August 14th. The ad mentioned that the exhibition would be along the plan of the Polytechnic Gardens at London "and has been pronounced by all who have witnessed it to be the best thing introduced into the United States, to which fact every one who visits it will certify. The press of the eastern cities have been enthusiastic in its praise, and says: 'it is the best family exhibition ever presented to the public.'"[3] A Mr. Henderson was listed as the "Chemist" for the exhibition, a Mr. Conner the business manager, John Black the advertising agent, and J. W. Buhoup as lecturer.

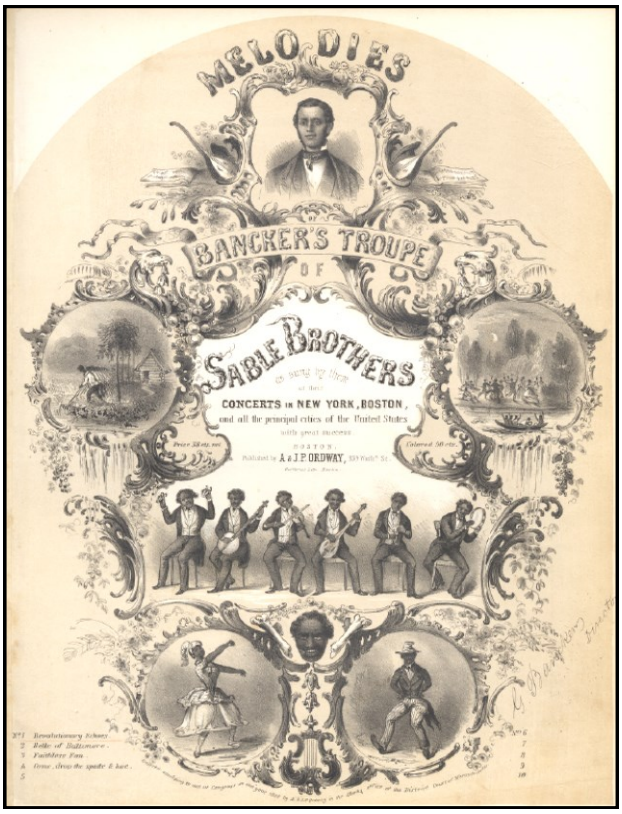


Fig. 1. *Melodies of Bancker's Troupe of Sable Brothers*. Words and music composed and arranged by J.G. Evans of the Sable Brothers. Published 1848 by A. & J.P. Ordway, Boston.

Levy Sheet Music Collection, Johns Hopkins University.

In October 1854, the *Meigs County Telegraph* of Pomeroy, Ohio, noted that Buhoup's Chemical Dioramas would be exhibited there soon, and admitted that they were "unacquainted with the exhibitors or the merits of this particular exhibition," but that "the most pleasing exhibitions they had witnessed had been of this type." They then quoted the Wheeling *Argus* newspaper report on the show at Melodeon Hall. "There is no mistake but these works of art are well worth seeing. Every person who has seen dissolving views may visit these representations and see

something new; those who have never seen dissolving views heresofore exhibited in the city should by all means . . . see Buhoup's Chemical Dioramas."[4]

The "Polytechnic Gardens" in London was corrected to the "Polytechnic Institute" in October advertising. Advertisements claimed that the show "but lately arrived in this country" and spoke of the enthusiastic praise of the press of Eastern cities. No specific newspaper names are given, nor are any quotes from the papers copied, as was common in advertising at the time. One view of Wales is mentioned, but no other details. I have found no record of what would seem to be this show in the Eastern newspapers on line.

The name "chemical diorama" is rather unusual. It was applied to two kinds of shows. One used dioramas on the principal of Daguerre's diorama: a painting on canvas that could be lit from the front, then the back, giving the illusion of two different scenes, often with a change from day to night. Showmen Maffey and Lonati, both from French families with a long tradition in show business, came to the United States to show what they claimed were dioramas by Daguerre. That's very doubtful: the canvases were much smaller than Daguerre's, and were not illuminated by natural light. But the show was very successful. They began to call their exhibition "Daguerre's Magical Pictures," and then, in Cincinnati, Ohio, in 1842, "Daguerre's Chemical Pictures." Robert Winter saw Maffey and Lonati's show, copied it, and showed his "chemical paintings" to great success. In 1844 he began to call these "chemical dioramas." From the descriptions and family letters, it is clear that these were double effect dioramas, although Winter later added a magic lantern to his show, which traveled extensively for decades in the United States, Canada, and even Central and South America.[5]

The second type of show consists of dissolving views, with the term "chemical" probably referring to the "Drummond light," or "limelight," used as an illuminant. It's also possible that "chemical" was used to refer to another discovery by Daguerre—photography; early on, this was often referred to as a great "chemical discovery." The Daguerre diorama was not new, but a "Chemical" diorama might lead potential audience members to believe they would see photographic images.

At any rate, Buhoup continued to travel with his show; advertisements often used the same text as the one quoted above. A family document mentions sound effects accompanying the dioramas, along with marionettes and ventriloquism as parts of the show.[6]

☞ *A Rich Entertainment*, of a Scientific and Literary character, is promised to our citizens, in Buhoup's Chemical Dioramas, &c., to be exhibited at Court-house Hall, this week.—See Advertisement. Our cotemporaries speak highly of this Exhibition.

The Wheeling Argus says:—"Buhoup's Diorama drew a crowded house at the Melodeon last night. The exhibition is far superior to any other of the kind which has ever visited our city."

From the Martinsville (O.) Enterprise.

** It is far better to improve the mind, gratify the eye, and spend one's time and money in this way, than in appetital indulgence, and lounging about taverns, os reading novels!

Fig. 2. Advertisement for Buhoup's Chemical Dioramas.

Monongolia Mirror, March 17, 1855

In March 1855, the *Monongalia Mirror* of Morgantown, Virginia [later West Virginia], announced the "the rich entertainment" to be exhibited at Court House (Fig. 2). The Wheeling *Argus* was quoted: "the exhibition is far superior to any other of the kind which has ever visited our city." The Martinsville, Ohio *Enterprise* was also quoted: "It is far better to improve the mind, gratify the eye, and spend one's time and money this way, than in appetital indulgence, and lounging about taverns, or reading novels!"[7]

Up until this time, Buhoup was presenting his show in rented halls. In late May 1855, this changed: the *Daily Morning Post* of Pittsburgh wrote of BUHOUP'S HINDOO PAGODA, just completed by Allegheny carpenters Boyd and Murdock. Mr. Buhoup had difficulty, it seems, in obtaining a hall large enough to hold all his patrons, so he had this "beautiful moveable Pagoda," capable of holding twenty-four hundred persons, built at considerable expense.

A description of the Pagoda follows: "It consists of thirty-two handsomely ornamented wooden panels, each six by twelve feet in dimensions. Four of these panels, bolted together, form one side of an octagon, sixty-four feet in diameter, and nearly two hundred in circumference, the whole being protected by an oil cloth covering, sustained by a center pole."

"The dioramas will be exhibited in a recess attached to the Pagoda, the interior of which is arranged to show them off to the best advantage. The Pagoda, although large, only weighs about 2,400 pounds, and will be transported along the Ohio and its various tributaries, during the coming summer, in two boats constructed expressly for the purpose."[8] According to a family document, the inside of the boat was painted entirely in black, and seated 200. [9]

People in Allegheny were to be given a chance to see the Pagoda when it was set up in "the Diamond," the city having given Buhoup free use of one of the public squares for a time. Reportedly, crowds arrived nightly to see the show in the "beautiful structure," the show consisting of the Chemical Dioramas, Coromatype [sic] Views, etc. [10]

The show began to travel. A brief digression into showboat history is in order. The elaborately decorated, self-powered sternwheel steamboat traveling the Mississippi River is probably what most people envision when they think of a showboat. This was not Buhoup's showboat. Early showboats were fairly primitive and were "towed" (pushed, actually) rather than being self powered. Settlers traveling west often traveled by river: roads, if they existed at all, were bad. It was far easier to move people and goods by river, using canoes, keel boats, and barges; settlements generally grew up along rivers.

In 1817, Noah Ludlow and a company of 11 arrived in Natchez-under-the-Hill, having traveled over 3000 miles in a 25 foot long keelboat, drifting down the river, steering with oars and poles. They stayed in Pittsburgh for three months performing in a theater, then bought a larger boat, called (of course) Noah's Ark, in which they continued to travel, although it's not certain if they performed on the boat at settlements.[11]

William Chapman is credited with the first showboat: he and his family were accustomed to traveling in a caravan to work in fairs in England. The nine members of the Chapman family arrived in America in 1827, worked in New York and Philadelphia theaters, before deciding to "go West" as so many others did at the time. In 1831 they were in Pittsburgh, the gateway to the West, and home of the leading riverboat construction company in America. Prospects for performing looked dim: the only theater in the city had been transformed into a machine shop. They built a log flatboat with a shelter covering a small stage and crude wooden benches. The boat would later be sold in New Orleans for building lumber or firewood; the actors would return to Pittsburgh by boat or train. The Chapmans continued to travel the rivers until 1847.[12]

John Banvard, who popularized the moving panorama in America, began his career on these early crude showboats, painting theater scenery and portraits. His journeys on the rivers inspired him to paint a moving panorama of the Mississippi, advertised as being three miles long, which it was not. But it made his name and fortune.[13]

In late June, 1855, the Grand Opening of Buhoup's Gorgeous Hindoo Pagoda took place in Pittsburgh, on land, with a Master Henry Madygan delivering an opening address. The exhibition was advertised as "the best of the kind on the Continent of America." On the second night, new scenes were introduced. The dioramas and Pyric fires were shown, and a band was on hand to accompany the performance. Newspapers noted that the Pagoda was more comfortable than a hall could be on warm nights.[14] The *True American* of Steubenville, Ohio wrote of the Pagoda on July 25, 1855, pronouncing the show "the best of the kind we have ever witnessed," and that the large audience was pleased with the show. [15]

The last night of the Hindoo Pagoda in Wheeling, Virginia [later West Virginia] was July 31. ALL the beautiful scenes would be produced, wrote the local paper. And something new had been added: Buhoup's lecture on Ventriloquism, in which he explained ventriloquism and gave "many very amusing experiments."[16]

In November 1855, the *Spirit of the Times* of Ironton, Ohio wrote that recent exhibitions there had included Bullard's moving panorama of the city of New York, Winter's Chemical Dioramas, and Buhoup's Hindoo Pagoda. Noting that the people of the area were famous for their patronage of amusing entertainments, and needed a relief from the toils and cares of daily life, the paper suggested that an arrangement be made for famous men, such as Henry Ward Beecher and Ralph Waldo Emerson, to come Ironton to deliver a series of lectures during the winter season.[17]

In 1856, the Great Floating Hindoo Pagoda stopped at Cairo, Illinois to exhibit. Buhoup advertised a "Grand Literary Entertainment" for Vevay, Switzerland County, Indiana (Fig. 3). There were to be two shows, at 2:00 and 7:00. However, the advertisement lists only the Chemical Dioramas and Chinese

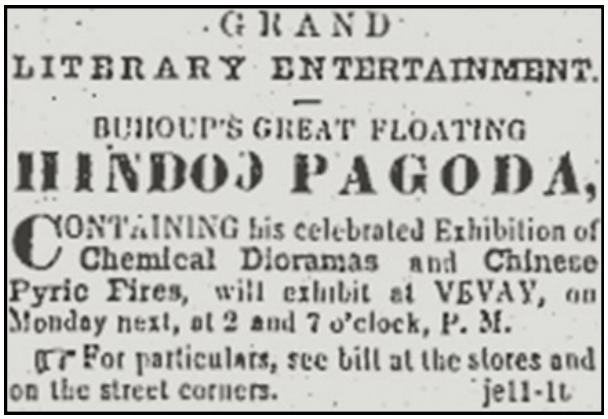

GRAND
LITERARY ENTERTAINMENT.
BUHOUP'S GREAT FLOATING
HINDOO PAGODA,
CONTAINING his celebrated Exhibition of Chemical Dioramas and Chinese Pyric Fires, will exhibit at VEVAY, on Monday next, at 2 and 7 o'clock, P. M.
☞ For particulars, see bill at the stores and on the street corners. je11-1t

Fig. 3. Advertisement for Buhoup's Great Floating Hindoo Pagoda. *Weekly Reveille* (Vevay, Indiana), June 11, 1856.

Pyric Fires. What was literary?[18] In September, the Pagoda was in Evansville, Vanderburgh County, Indiana. "If what we have heard of these Dioramas be true, we have never before had so beautiful an exhibition in this city." It was here that Buhoup's two daughters, aged two and four, first performed as vocalists in the Pagoda. Two shows were given daily. "Literature, Science and Amusements!" wrote the same paper, as the Pagoda continued its shows. "The Pagoda is large and commodious," it wrote, "will seat 800 people, is well ventilated, everything is conducted in a manner which renders it the most refined exhibition of the day."[19]

Disaster struck in April, 1857. The *Memphis Appeal* reported: "Destructive Conflagration and Loss of Life—Our citizens may remember the appearance at our landing last fall of an exhibition boat, gaily decorated entitled 'Hindoo Pagoda.' It remained here about a week, and for three or four consecutive days a car, containing a band of music, paraded the streets, drumming up visitors to the 'show.' The Pagoda was not very successful here, and started down the river, the proprietor Mr. Buhoup, intending to run up the small streams in the lower country."

On the 8th or 15th of April—different dates appear in accounts—the boat had burned, entirely consumed by fire in Trinity, Louisiana. Musician John Shay burned to death, and another person was so badly burned that he was not expected to survive; others were injured as they tried to reach the shore. Surprisingly, it was not the pyrotechnics of the exhibition that caused the fire. The boat had been at Trinity and the show given. Everyone on board retired for the night. About 1:00 in the morning, they were awakened in the midst of fire. One of musicians had put a lit candle on a table, without a candlestick, and left it burning when he went to bed. The candle burned down, set the table, drapes, and "chemicals" on fire. These were highly inflammable and the fire spread very quickly. Those who escaped saved none of their belongings. Mr Buhoup lost "his all," to quote one account: the boat, the exhibition, his earnings. These were valued at $4,300 (another account said $4,390) and there was no insurance. The citizens of Trinity took in the survivors.[20]

Buhoup became a merchant there; two years later the Harrisonburg, Louisiana *Independent* reported that a group of wealthy men had hired Buhoup as their agent, to build a steamboat in that town for the Red River trade. A sternwheel packet, designed for carrying freight and passengers, the boat was completed in late April 1859. The *John Ray*, as it was named, was loading for New Orleans, with J.W. Buhoup the captain. The boat left for Bayou Bartholomew on April 25.[21] In 1860 the *John Ray* snagged and was lost; Buhoup was not her captain at that time.[22]

Buhoup served in the battles of Bull Run and Manassas, and died in New Orleans while recruiting for the Confederate Army in January 1862.[23]

The show business seemed to be in the family's blood: his daughter Clara Packard, who had been a singer on the Pagoda from the age of four, became the owner of a San Francisco Theater, and in 1891 founded the Packard Theatre Exchange. Mrs. Packard's daughter, who used the name Maude Winter, was a promising young actress, who died at the age of 25 of consumption.[24]

Notes and References

1. Before presenting this paper at the 2016 Magic Lantern Society convention in New Orleans, I realized that I did not know the correct pronunciation of "Buhoup." According to John Woolf Jordan's, *A Century and a Half of Pittsburg [sic] and her People*, Volume 4, Lewis Publishing Company, 1908, pp. 76-77, The grandfather of John W. Buhoup was a native of Germany, and the original spelling of the family name was Beauchoupt, "which in time has become Anglicized into the present spelling and pronunciation Buhoup." Mark Packard, a descendent of Buhoup, wrote in an email that he himself is not sure of the pronunciation, but believes it should be B-YOU-OOP. There is no one with this surname in the United States now.

2. Many thanks to Kentwood Wells for information on Buhoup's career as a minstrel, which he discovered in *America's Historical Newspapers* online. I had been unaware of Buhoup's previous experience in "the show business."

3. *Wheeling Daily Intelligencer*, Wheeling, VA. August 12, 1854. https://chroniclingamerica.loc.gov

4. *Meigs Co. Telegraph*, Pomeroy, Ohio. October 3, 1854. https://chroniclingamerica.loc.gov

5. Suzanne Wray. 2007. R. Winter's Unrivalled Exhibition of

Chemical Dioramas, Chyrstalline Views, Chromatropes, &c: the traveling exhibitions of Robert Winter. *The Magic Lantern Gazette* 19 (4) (Winter 2007):8-19.

6. I am indebted to Mark Packard, the great grandson of J.W. Buhoup, for a written record of the Packard family made in December, 1968.

7. *Monongalia Mirror*, Morgantown, VA, March 17, 1855. https://chroniclingamerica.loc.gov

8. *Daily Morning Post*, Pittsburgh, PA, May 29, 1855. Was the weight of the Pagoda confused with the seating capacity here? http://digitalnewspapers.libraries.psu.edu/Olive/APA/CivilWar/#panel=home

9. Packard family record. The seating capacity of the Pagoda is quoted as 200, 800, and 2400 persons in different sources.

10. *Daily Morning Post*, Pittsburgh, PA, June 22, 1855. http://digitalnewspapers.libraries.psu.edu/Olive/APA/CivilWar/#panel=home

11. Wayne H. Claeren. 1976. Historical Society Notes and Documents: Pittsburgh and the first showboat: A new angle on the Chapmans. *The Western Pennsylvania Historical Magazine* 59 (2) (April 1976). Accessed via https://journals.psu.edu/wph/article/view/3415

12. Ibid.

13. Erkki Huhtamo. 2013. *Illusions in Motion: Media Archaeology of the Moving Panorama and Related Spectacles* (MIT Press, Cambridge MA).

14. *Daily Morning Post*, Pittsburg Pa. June 26, 27, 29, 30, 1855. http://digitalnewspapers.libraries.psu.edu/Olive/APA/CivilWar/#panel=home.

15. *True American*, Steubensille, Ohio. July 25, 1855. https://chroniclingamerica.loc.gov

16. Wheeling *Daily Intelligencer*, Wheeling, VA. July 31, 1855. https://chroniclingamerica.loc.gov

17. *Spirit of the Times*, Ironton, Ohio. November 13, 1855. https://chroniclingamerica.loc.gov

18. *Weekly Reveille*, Vevay, Switzerland County, IN. June 11, 1856. Hoosier State Chronicles, https://newspapers.library.in.gov

19. *Evansville Daily Journal*, Vanderburgh County. September 1& 2, 1856. Hoosier State https://newspapers.library.in.gov

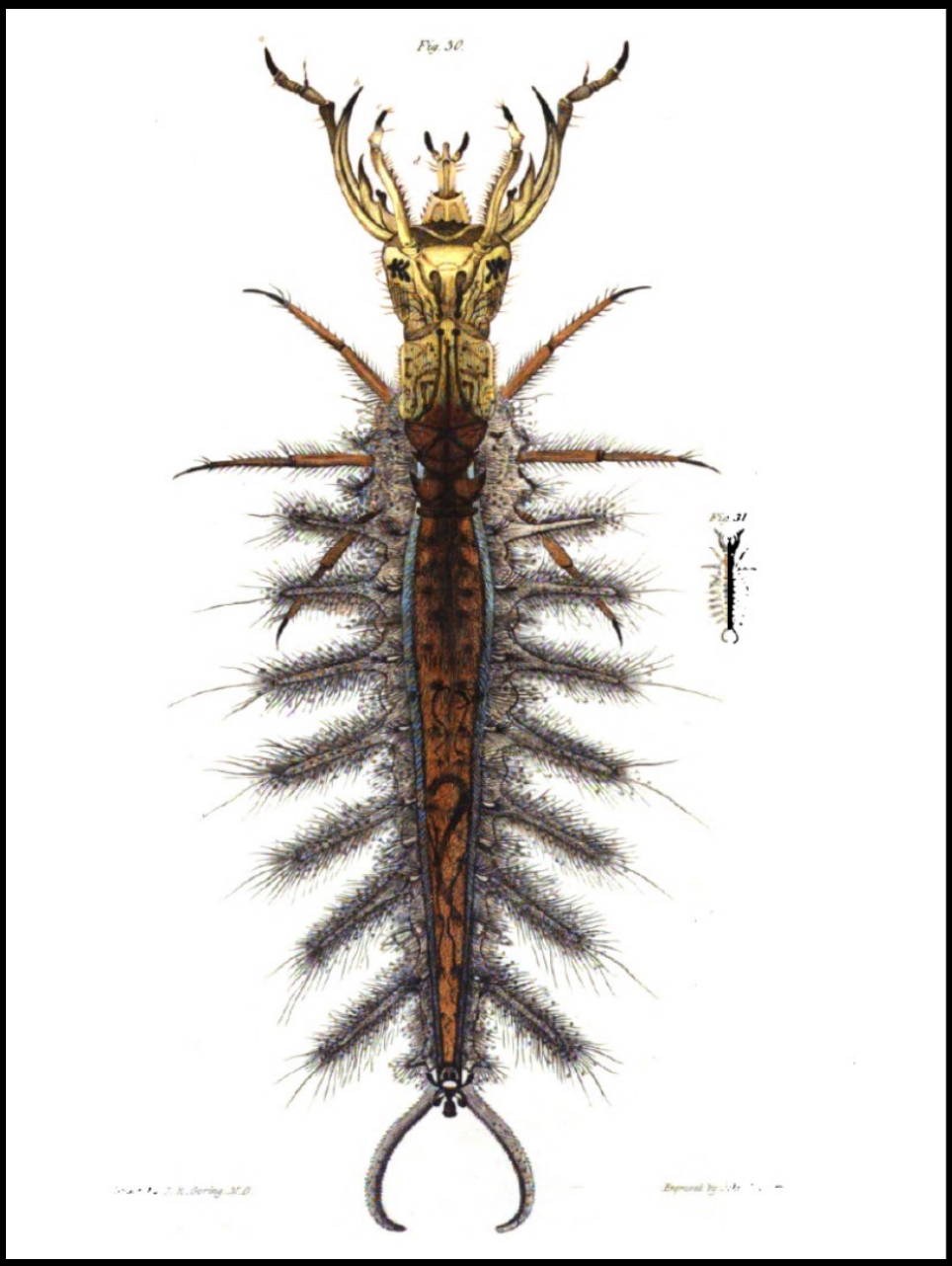
20. *Memphis Appeal*, April 1857. This article is transcribed on the Catahoula Parish History website. It was contributed by Mark Packard, great grandson of J.W. Buhoup. http://www.catahoulahistory.com/webpage4
Other accounts of the fire appeared in the *Evansville Daily Journal,* May 4, 1857, and the *Indiana Reveille*, May 6, 1857, Hoosier State Chronicles, https://newspapers.library.in.gov

21. *The Independent*, Harrisonburg, LA. April 27, 1859 and *New Orleans Daily Crescent*, April 25, 1859. https://chroniclingamerica.loc.gov

22. UW La Crosse Historic Steamboat Photographs has an image of the *John Ray*, and lists details of her loss. http://digicoll.library.wisc.edu

23. *Clara D. Beaumont Life and Times and Family*. I am indebted to Mark Packard for a copy of this document, which contains a transcription of J. W. Buhoup's obituary from the *Daily Picayune*, New Orleans, Louisiana, March 2, 1862.

24. Ibid. Co-incidentally, Clara Packard's Theatre Exchange was located in a building opposite the old Metropolitan Opera House in New York City. I work in the office building constructed on the site of the "old Met."



Above: Larva of an aquatic beetle in the genus *Hydrophilus*, often called a Water Tiger or Water Devil. A live Water Tiger being fed smaller insects often was the high point of an oxy-hydrogen microscope exhibition.

M.D. Goring and Andrew Pritchard. 1833. *Microscopic Illustrations of a few New, Popular, and Diverting Living Objects. . . .* (Whittaker, Treacher, and Arnot, London).

Front Cover: Woodcut illustration of Mr. Weldon's hydro-oxygen microscope exhibition at Scudder's American Museum in New York, 1835. Like most such illustrations published in that era, it is biologically quite inaccurate. The accompanying text says it is a "faithful represention of the appearance of a drop of water," but most of the animals depicted are not microscopic organisms, but macroscopic insects that could not live in a single drop of water. Winged insects that don't live in water at all are included.

"Hydro-Oxygen Microscope," *The Family Magazine*, vol. 2 (1834-1835), p. 379.